QST

VOLUME III OCTOBER, 1919 NO. III

CONTENTS

3. Building Your Own C. W. Apparatus
7. Not So Rotten — The Old Man
8. How to Put Up a Good Mast
10. Amateur Tests from NAH
11. Editorials
15. Efficient Short Wave Transmitters — Guy E. Wilson
16. The Operating Department
22. The Connecticut Tube
24. A Compact Small-Capacity Switch — Chas. E. Pearce
25. New Transmitting Apparatus
26. Radio Communications by the Amateurs
30. Amateur Radio Stations—Pictorial Section
31. "Strays"

QST is published monthly by The American Radio Relay League, Inc., at Hartford, Conn. Kenneth B. Warner (Secretary, A. R. R. L.), Manager and Editor.

Subscription price, $1.50 per year in the United States and possessions; Canada, $1.75; Foreign, $2.00. Single Copies, 15 Cents.

Entered as second-class matter May 29, 1919, at the post office at Hartford, Connecticut, under the Act of March 3, 1879.

Copyright, 1919, by The American Radio Relay League, Inc.
Title registered at United States Patent Office.

THE AMERICAN RADIO RELAY LEAGUE, Inc.
HARTFORD, CONN.

"NOT SOLD!!"

This was the answer you received when you attempted to purchase these coils unmounted

RADISCO HIGH FREQUENCY INDUCTANCES
(Universal spaced winding)

The men who build their own radio apparatus have long realized that the above type of coil is the most efficient coil for Radio Circuits—but, heretofore, they have not been able to purchase these coils unmounted.

To fill their need, RADISCO agencies have placed these coils in stock.

Coils may be purchased with or without taps as desired but, by purchasing coils with taps, ONE COIL MAY BE USED TO COVER THE ENTIRE RANGE OF WAVE LENGTHS THAT IT IS DESIRED TO RECEIVE.

Within a short time there will be a Radisco Agency in every part of the United States. If none is established in your vicinity at this time, and you desire further information, address the

RADIO DISTRIBUTING COMPANY, 312 FLATBUSH AV., BROOKLYN, N.Y.

RADISCO AGENCIES:

Bienville, Que., Can.	Canadian Radio Mfg. Co.
Boston, Mass.	Atlantic Radio Co., 34 Batterymarch St.
Brooklyn, N. Y. .	Kelly & Phillips Elec. Co., Flatbush Ave., bet. 7th & 8th.
Newark, N. J.	A. H. Corwin Co., 924 Kinney Bldg.
New Orleans, La.	L. A. Rose, 4323 Magnolia St.
Providence, R. I. . .	Rhode Island Elec. Equip. Co., 45 Washington St.

OCT -1 1919

©CLB437792

Q S T

A Magazine Devoted Exclusively to the Radio Amateur

Building Your Own C. W. Apparatus

DOPE on new developments in amateur undamped reception comes in fast and thick these days—so much so that we can't publish it all. Yet all of it is so interesting that we have decided to combine it in one article, presenting the essentials but eliminating the repetitions bound to occur in a number of articles on the same subject. The Editor acknowledges his indebtedness to the following contributors: Mr. Wm. H. Seabury, 1056 Beacon Street, Brookline, Mass.; Mr. Wm. E. Woods, St. Louis; Mr. Guy R. Entwistle, Boston; Mr. Clinton H. Turner, North Reading, Mass.; Mr. J. A. Crowdus, St. Louis.

Perhaps the most interesting apparatus is that in use at the station of Mr. Seabury. Like the other modern CW sets it consists of three inductance coils with the usual accompanying capacities, but the circuit, shown in Fig. 1, is altogether different from the hitherto published amateur undamped sets. This circuit is known as the Eaton Oscillator, a hookup that is now used at Otter Cliffs, the busiest coast station in the country, and while fairly well known to amateurs in the Boston district, is entirely new to most of our readers. Capacitative feedback is employed to make the bulb oscillate, instead of the more common plate tickler coil. The theory can be set forth simply as follows: A change in plate current imposes a charge on C4, which sets the secondary circuit into oscillation. During these oscillations, similar changes in potential occur across the terminals of condenser C3, across which the grid and filament are connected, so that corresponding changes in potential are impressed upon the grid in such a manner as to sustain the oscillations thru the internal functioning of the tube. The third coil, while not a tickler, occupies the same position in the set-up as does the tickler in the commoner circuits, but in this case serves the dual purpose of acting as a wavemeter and at the same time functioning as the well-known "sensitizing circuit" ascribed, we believe, to Dr. Austin, whereby increases of signal strength of from three to four times are obtained. In CW circuits such as this, a beat note is produced by setting the grid circuit into oscillation at a frequency differing from the incoming frequency by a value equal to the desired tone, and in this case, the reactance of the grid circuit to the local oscillations is zero but the reactance and therefore the impedance to the incoming oscillations is considerable, and a loss in energy results simply from this slight dissonance. By coupling on this sensitizing circuit, the grid circuit is given two frequencies, in such a manner that the reactance to the incoming signals is also zero and the signal strength accordingly increased. With a calibrated condenser, this circuit forms a direct-reading wavemeter and is a great convenience.

Mr. Seabury's coils are homemade, er-

Fig. 2.

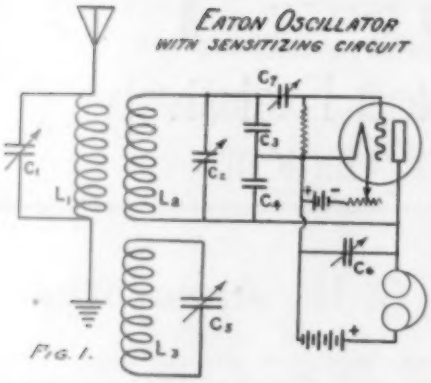


FIG. 1.

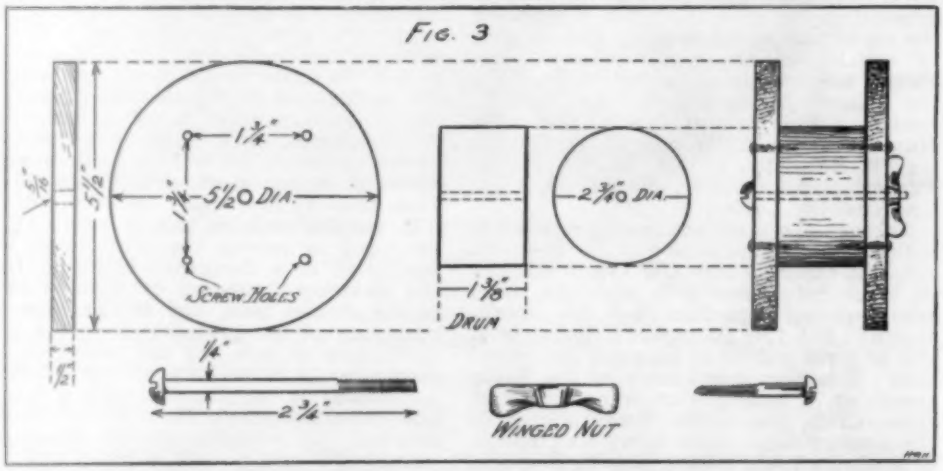
ploying no methods the amateur cannot duplicate, and the set is compact, easy to construct, and has no expensive mountings, as the coils are slid along the table to vary coupling, altho they of course may be mounted if desired. Fig. 2 shows the finished coils. This set was used with a single-wire antenna having an overall length of 350 feet. If antenna dimensions differing very greatly are used, compensation in the primary must be made. The values of inductance and capacity are as follows in Mr. Seabury's coils:

L1	23.19	millihenries.
L2	39.86	"
L3	28.70	"
C1	.0030	mfds.
C2	.0025	"
C3	.0005	"
C4	.0050	"
C5	.0040	"
C6	.0020	"
C7	.0010	"

All of the coils are wound with No. 3-16-38 Belden H. F. Cable (Litzendraht). The highest possible efficiency is thereby attained, and altho solid wire can be used with fair efficiency and a considerable reduction in cost, the builder is strongly advised to use Litz if it can be afforded. The coils are wound on a wooden form, the construction of which is shown in Fig. 3. This is used only during construction, later being discarded. The drum and end pieces must be well fitted, to prevent the wire slipping down. The following instructions should be observed in winding.

Over the drum is placed a sheet of ordinary wrapping paper, and over this a layer of common brown string is wound. The string must be uniform in diameter and free from bunches or it will cause an uneven winding. Leave ends of string hanging out to be used later. Over the string the Litz is wound, leaving about four inches for leads. The primary has 14 layers of 30 turns each, the auxiliary coil 15 layers of 30 turns each, and the secondary 17 layers of 30 turns each. A layer of ordinary wrapping paper is placed between every two layers of winding. The completely-wound coil is paraffined, and a pointed ivory paper cutter or similar de-

FIG. 3



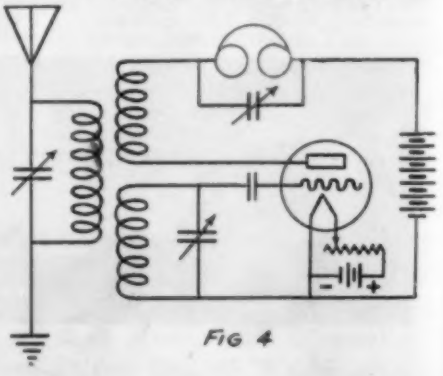


FIG 4

vice run around the circumference on one edge to cut thru the surplus paraffine, preparatory to removing one end piece. Extreme care should be taken not to disturb the winding. One end is taken off by removing the screws, and the outside "rim" of the coil given a coat of paraffine. The other end is similarly treated, after which the string is pulled out from either side so that with the assistance of the paper cutter the coil may be removed from the drum. The inside is then coated with paraffine. Two-foot leads of lamp-cord are soldered to the ends of the windings and the coil is then taped with half-inch linen tape, threaded transversely thru the center hole as with a bicycle tire. In taping, get a few turns around the leads to safeguard them against breaking off. It is very important to remove all the enamel from the soldered connection if a good job is to be done, as otherwise the high resistance would overcome the benefits of having used Litz. The enamel may be removed readily by heating red hot over an alcohol lamp and plunging into a saturated solution of pure grain alcohol and saltpetre.

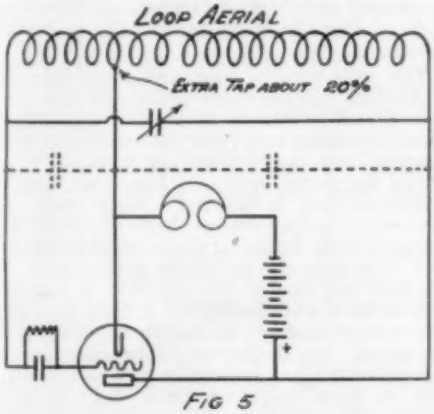


FIG 5

The wavemeter coil is shunted by an ordinary .001 mfd. Murdock condenser filled with castor oil, which increases its capacity about five times. The tops of the screws can be shellaced to prevent capillary leakage.

The operation of this set is very simple. The feedback is not variable, these values of C3 and C4 having been determined by experiment to be best. Accordingly the primary and secondary are tuned in the usual manner, with a suitable coupling. The auxiliary circuit is then tuned as before described, and if calibrated as a wavemeter will prove most convenient in the locating of any desired tune.

This oscillating circuit is adaptable of course to the Honeycomb Coils as well, and it should be understood that the sensitizing circuit may be employed to equal advantage

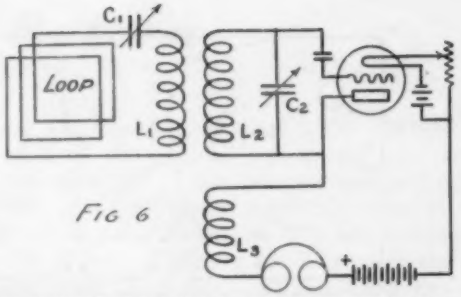


FIG 6

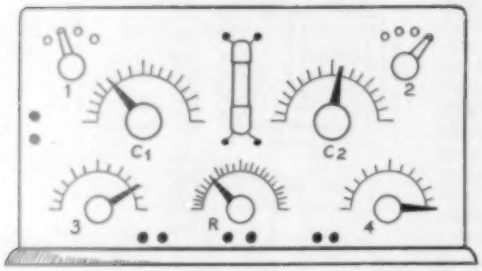
on inductive-feedback sets, four coils then being necessary.

Mr. Turner uses a similar method in building his coils except that they are all wound on a form 2 inches in diameter and with 1-inch width of winding. The rod thru the center of the form is mounted in standards and the end bent into a crank, forming a quite convenient winder. He uses one pound of No. 30 D. C. C. wire for the three coils, 50 turns to the layer, with 20 layers or 1000 turns for the primary and 16 layers or 800 turns for the secondary and tickler. We rather imagine the proportions of primary and secondary could be reversed to advantage. He winds his coils very similar to the method employed by Mr. Seabury but after each layer brings the wire back to the starting side of the coil with one diagonal turn around, and uses thin bond paper between each layer. The primary and secondary are operated with shunt condensers for tuning, and the circuit is a tickler feedback, as shown in Fig. 4. We believe better results would be had by the use of the ultraudion circuit shown by Mr. Crowdus in the September QST—a very simple change—altho he is copying Nauen and Carnarvon on one tube.

Any of these coils, and likewise those described by Mr. Crowdus, can be used on a loop aerial, particularly the large rectangle described in September by Mr. Woods, by connecting the loop to the primary in series with a large variable condenser of about .005 mfds. capacity. It should be borne in mind, however, that an amplifier is a necessity for practical work with a loop. But with the simplification of cir-

— 3 REQUIRED —

FIG. 7



Nos. 1 and 2 Steps of Fixed Condenser shunting Variables

Nos 3 and 4. Primary and Secondary Variable Condensers

C1 Secondary Coupling
C2 Tickler Coupling.

R "A" Battery Rheostat.

FIG. 8

cuits so that both oscillator and amplifier operate from the same "A" and "B" battery, and with the many excellent amplifier transformers on the market, this has been reduced to the simple necessity of possessing an extra bulb.

In this connection why should it be necessary to use coils on the operating table? Why not couple the plate and grid circuits thru the loop itself, by taking a tap off the rectangle at about 20% of its inductance, with a circuit like Fig. 5? We suggest that experimenters with loops try this. All it requires is a third lead into the station. The Editor would be pleased to learn the results experienced with this arrangement.

Mr. Woods has favored us with a description of a cabinet set designed for use with the large rectangle described by him in September. The circuit, shown in Fig. 6, is self-explanatory and presents no new features. The coils should have an inductance of approximately 30 millihenries, and are permanently wound full with No. 20 wire, enameled, cotton or silk, on turned wood forms as shown in Fig. 7. No taps are made. The wire is wound in regular bank formation and, while considered grossly inefficient by the advocates of the new style windings, will give very good results in practical usage. Litzendraht of course should be used if it can be obtained, but is not essential.

The actual tuning is accomplished by only two condensers, one in the leg of the loop and the other across the secondary. They are of rather high capacity, about .005 mfds., and as a variable of this capacity is an expensive piece of apparatus, this design contemplates a substitute consisting of a standard 43-plate variable shunted by four steps of fixed condenser, each step having a value of .001 mfd. In operation, when the end of the scale is reached, the condenser is returned to zero, the first step of fixed capacity is cut in, and the operation repeated.

The coils may be mounted on a slide rod if desired, but as short leads are desirable in a circuit of this sort, a cabinet is shown which contains not only the coils and condensers but the audion as well. Fig. 8 shows the panel, while in Fig. 9 an idea is presented for mounting. Note that the secondary, in the center, is fixed, while the primary and tickler are mounted on either side, the primary so as to rotate thru 90 degrees and the tickler so that it may be moved back and fourth by a rack and pinion arrangement. It would be very convenient if the tickler could be mounted as the primary, but generally a tighter coupling is here required than that method makes possible. A hinged arrangement

(Concluded on page 14)

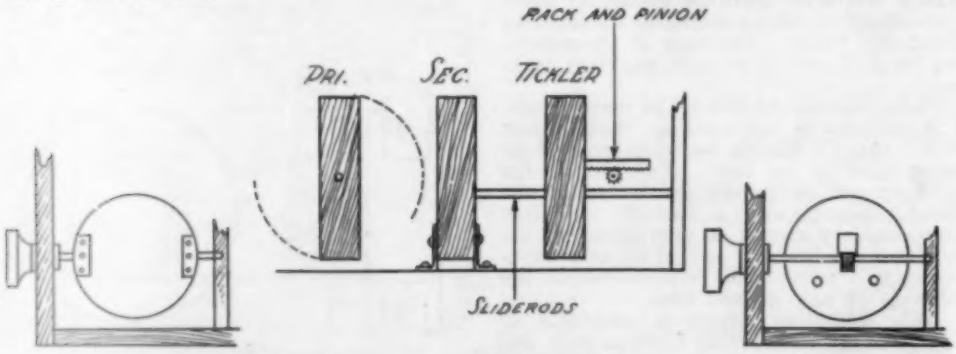


FIG. 9.

Not So Rotten

By The Old Man

WELL, say, you Editor chap down East there, just present my compliments to the distinguished scientist who wrote that article in September QST on Non-Synchroncus Gaps. Tell him for me I hope his shadow will never grow less, his motor never ground and that he may live long and prosper. He's all right and his gap is likewise.

I considered up to the time I read the article that I had the only real rotary gap in the world. I have seen many gaps in my time, professional and amateur, but I never saw one as good as mine until this new one appeared. Once I had a peek at the old timer the Marconi Company inherited from the New York Herald at Siasconset. She was locked up in a cupboard under the operating table and they used to pull the door open at night sometimes to show the greenhorns the fire works. She was pretty savage all right and spat fire from every corner, but later on my old Betsy made her look like a tabby-cat.

Old Betsy takes a half horse power motor to whirl her around. By Heck, she ought to be worth something, don't you think? Uses darned near as much power as the transformer. But, son, when she gets really into action you can understand why it takes a half horse. She twists around just a little over seven thousand revolutions per minute and she is eighteen good inches in diameter. She roars like some pesky varmint just crazy to eat you and you can feel the hair just ready to raise up on the back of your neck. The nearest thing I know to her is a flivver when you crank it with the throttle wide open and you catch your coat in the headlight and can't get back to shut her off for what seems like half an hour or so.

Like my friend's pet skunk, she is not a pleasant companion to have in the same room with you, but placed down cellar and covered with an old quilt, and operated by distant control she isn't so bad when you get the head-phones down tight. When I go down cellar to oil her up and give her the juice just to see how my sand is holding out as the years roll on, I make it a point to keep out of line with the business end of her. I happen to know what she's like when the cover is off and I also know how those four brass studs are fastened on. I don't fancy one coming loose and colliding with me about amidships. Yes—Betsy is a loud speaker all right and her spark used to fetch in the good old days just about what you would fancy it might.

But, I'm doggoned if I don't half suspect this new one in QST has her licked. I think I will make one like it some day and hook on the half horse power with about a five to one pulley ratio and give her a whirl. I suspect I shall stick to distant control and the old quilt, because I have a notion that with ball bearings she will still have a voice like an angry fog horn.

I don't know about feeding her booze, however. The distinguished scientist tells about dripping alcohol into her system to make her lively. It may be all right for a rotary gap to have a hydro-carbon breath most of the time in order to improve quenching action and to put in a pop relief-valve to ease her when she belches wind, but I fear me that it would take some pop-valve to keep the bakelite sides and the O.T. and most of the rest of the machinery from leaving for parts unknown if she ever happened to get just the right mixture and it ignited. It would be some belch.

No—I veto the booze business. Booze is all right for me but it's all wrong for the other fellow. In a man, just the right mixture turns him into a pretty violent sort of an article. But, a rotary gap going 7000 odd revolutions per minute, badly stung in the snoot, screeching like a Big-4 locomotive filled with wildcats, and chasing you around the cellar, would be too much for my kind of a nervous system. Me for prohibition when it come to letting down the bars to rotary spark gaps.

(Concluded on page 14)

How to Put Up a Good Mast *

Providing a suitable support for the antenna is probably the most difficult single feature about establishing amateur operation. To hire a contractor to put up a 100-foot self-supporting steel tower is no doubt the method deluxe and a thing we dream about, but there are few of us who can afford that, and there are few home-made poles over 60' that will stand the gaff of a few seasons of amateur work.

This article is a description of a good 80-foot pipe mast which can be erected for a cost of around $15 and will give good service. A sketch of the complete pole is shown in Fig. 1, from which it will be noted that it consists of a timber, A, and three sections of pipe, B, supported by wires at each joint. The timber is provided with an iron collar at the top, thru which the pipe is raised; and a small platform 6 feet from the top, from which the work of erection is conducted.

In Figs. 7 and 3 are shown the details of the timber which is preferably a 6-inch by 6-inch, long enough to stand 28 or 30 feet out of the ground. The length imbedded in the ground depends on the nature of the soil. If good hard ground, the ideal way is to imbed it in concrete. In the author's case, hard clay was struck at about 4 feet, and a buried platform 3 feet square, as shown in Fig. 2, provided ample bearing.

Details of the iron collar are shown in Fig. 3. This should be made of ⅜ inch by 2-inch strap iron. Any blacksmith can do the job. It has a loop securely riveted on it, made of the same stock, of such dimensions as to pass a pipe 2 inches in outside diameter. It should also be drilled for securing the guy cables, and then fastened to the top of the timber with heavy lag-screws.

The platform on the mast is 2 feet square, supported on two pieces of 2x6, bolted to the timber. The details are clearly shown in Figs. 7 and 3. Note that a space 6 inches by 6 inches is provided alongside the timber and between the supports of the platform.

Standard pole-steps are provided and the woodwork is given two coats of mineral red paint, and the portion to go underground preferably tarred. The pole is then raised in the excavation before-hand provided. It should be securely guyed by three seven-strand ⅜" galvanized cables affixed to the iron collar, and trued up by means of turnbuckles.

We are now ready to proceed with the erection of the pipe, which is composed of 20-foot lengths of standard 1¼-inch galvanized well-pipe, or black pipe of the same size properly protected by a preserving paint. Do not use pipe unions between the joints. They are not strong enough. A good joint may be made, as in Fig. 5, by butting the ends together and bolting thru a sleeve consisting of a 2-foot length of pipe just large enough to slip on.

Erection is accomplished as follows: The top piece of pipe is inserted thru the 6x6 opening in the platform supports and thru the loop in the iron collar, and temporarily suspended so the top is just a few inches above the collar. Aerial pulley and halyard are fastened with an eye-bolt thru the end of the pipe and the top set of three No. 12 galvanized iron guys secured around the pipe above the bolt. From his position on the platform the erector can easily raise the pipe hand over hand until it is high enough to couple on to the second section in the manner shown in Fig. 5. The two coupled sections are then raised until the coupling is just above the collar, where they are temporarily suspended by a hook inserted in the bottom pipe, and the second set of three guy-wires attached.

From this point on it will be necessary to enlist the services of neighbors to hold and pay out guy-wires. The two sections are raised in the same manner high enough to couple on the third section. After this it will be necessary to resort to block and

*Rewritten from an article by K. B. Warner in Popular Science Monthly, by the courtesy of the Publishers.

FIG. 1

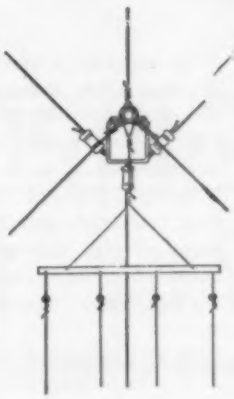


FIG. 4

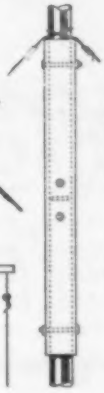


FIG. 5

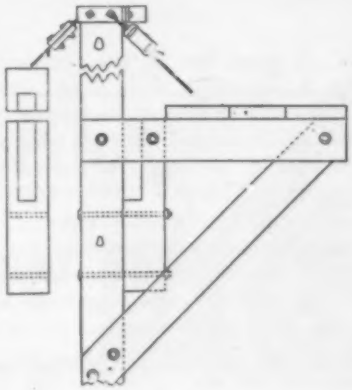


FIG. 6

FIG. 7

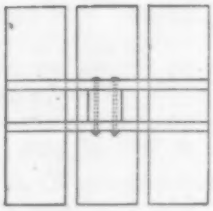


FIG. 2

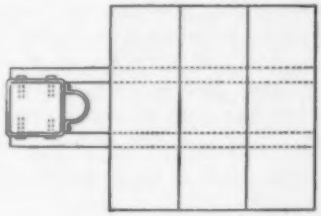


FIG. 3

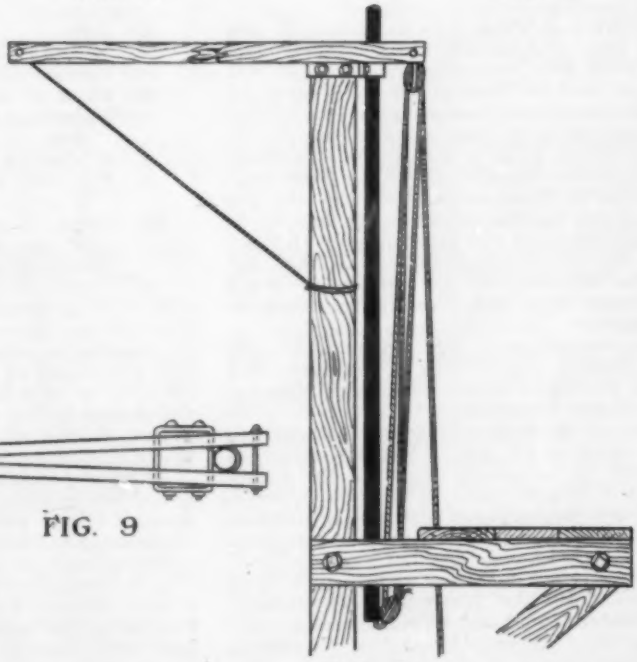


FIG. 8

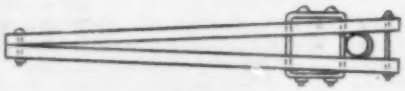


FIG. 9

HRH

tackle. A good way to use this is shown in Fig. 8, in which it is noted that the temporary arm, made of two 5-foot pieces of 2x4, as illustrated in Fig. 9, straddles the pipe and is securely guyed in its position at the rear. The pressure brot to bear on the arm is all downward, and a few nails thru a block between the members will hold it in place temporarily. Tackle is rigged between a bolt on the open end of this arm and a single block in the bottom of the pipe, and the three sections of pipe may then be easily raised, pausing to attach the third set of guy-wires as the last joint gets above the collar.

The bottom of the pipe is fastened to the side of the pole at the height of the platform by stepping it in the block shown in Fig. 6. This may be of 6x6 cypress, 2 feet long, and is hollowed out on the side next the pole to receive the pipe as shown. It is securely bolted to the platform supports and the timber as indicated. A rope hitch around the pipe will suffice to lower it gradually into hole, after which the guy-wires are trued up and the mast is complete.

Several poles of this construction, except that standard couplings were employed instead of pipe sleeves, have been in service three or four years, supporting heavy aerials thru winter sleet and 60-mile squalls.

It will be found very desirable to employ a duplicate guy wire from the top of the pole on the side away from the aerial, to help take the pull against it. The guy-wires should be broken up into short lengths with porcelain knobs, to prevent energy absorption, and should be set out as far as possible from the base of the pole. This design is of course flexible and the builder can add an additional 20-foot section of pipe if desired.

Amateur Tests From NAH

So much interest was expressed in the Navy tests transmitted for amateur reception from NAJ, as announced in QST for August, that we went to see the Navy folks on this coast and proposed that similar test messages be sent from some station in the Third Naval District to give the Eastern amateurs the benefit of the same practice.

Authority has now been received by the New York Central Control Station to do this, and the tests will commence on October 5th, this date being chosen so that the October number of the various technical magazines may first give due publicity to the matter.

The transmission will be by NAH, on 1500 meters, and will be in the form of a coded broadcast addressed to all amateurs, transmitted immediately following the completion of the 9:00 p.m. press—which is to say, about 9:45 p.m. Various items of interest to amateurs, such as the establishment of new stations, changes in wavelengths or schedules of high-power stations, etc., will be transmitted in this broadcast schedule. The code has not yet been published but any amateur may obtain it on request from the District Communication Superintendent, 44 Whitehall St., New York City. When writing this request an amateur should give the following information:

1. Name.
2. Address.
3. Age.
4. Military service, if any.
5. Commercial radio experience if any.
6. Class of operator's license, if any.
7. Receiving speed in words per minute.
8. Education.
9. Size and power of his transmitter, if any.
10. Type of undamped wave receiver, if one installed.
11. Name of any radio organization or club to which he may belong.

The Navy Department has come to appreciate that the amateur world constitutes an invaluable source of skilled operators, and the object of this broadcast is to give training in copying code, in line with the announced policy of the Office of the Director of Naval Communications to cooperate in every way with the amateurs.

The Navy needs qualified CW operators, and there is quite a trick to tuning an undamped set, so we suggested the desirability of undamped transmission to afford tuning practice, and on 2500 meters, so that the simple arrangement of an oscillating tube would permit amateurs who possess no long-wave undamped set to become familiar with CW; but there is no medium-power undamped wave transmitter in this district at present, unfortunately. We are hoping this can be arranged later, as it would add considerably to the value of these tests.

DANIELS ONLY KNOWS

Why are we not opened up? Daniels only knows! Another month has rolled around and still we are unable to get any action from Washington or get any reason for inaction. Everybody tells us the same thing—that it is up to the Secretary of the Navy. And everybody, when you ask them why the Secretary of the Navy acts the way he does, makes a different guess. You can hear anything you are looking for. We wonder if the Navy Department, and Mr. Daniels especially, has a full realization of the bad odor that is rising around this amateur radio matter. If popular sympathy for the Navy is a desirable thing to have, it is very unfortunate that amateur restrictions are not removed or a reason given why they cannot be.

In order that all amateurs may be in the position to form their own conclusions, we will state the situation of affairs, exactly as it is, up to going to press with this issue of QST.

As Mr. Daniels seems to be the sole possessor of the secret why the lid continues down, the A.R.R.L. has had a resolution introduced in Congress requesting the Secretary, insofar as compatible with the public safety, to furnish the reasons why the restrictions have not been removed. This document is known as House Resolution 291 and has been referred to the House Committee on the Merchant Marine and Fisheries. We hope Mr. Daniels will not attempt to evade the issue but will come forward like an American and give us an explanation.

Now about that new legislation. On August 28th the Navy Department furnished the Senate Committee on Naval Affairs a tentative draft of a proposed new radio bill which would repeal the old law of August 13, 1912, under which we now operate. This is the "government monopoly" bill we have heard so much about. It provides, however, for the existence of amateur stations and for a few other classes, and contains provisions for the issuance of station and operator's licenses under the Department of Commerce, as of old. There are a number of more or less important features in it which are objectionable from the amateur standpoint but the big thing is that instead of providing regulations for wavelength, power, etc., this bill would provide for the existence of a technical radio committee, composed of one representative from each department of the government, who in closed session would formulate and promulgate regulations concerning wavelength, power, decrement, purity, operating procedure, etc., for all the classes of stations. This new law states we should use no wavelength except that set for us by the committee, and then leaves the regulations to be framed from time to time at the discretion of the committee instead of being definitely set forth in the law. This is small assurance for the continuance of amateur radio, with our destinies entirely in the hands of a government committee who would not be empowered even to hold public hearings where the affected classes of stations could explain their cases.

Our Board of Direction has held meet-

ings and laid out a plan of action and the matter is being handled vigorously . We are out to have the restrictions on amateur transmitting removed, or a good reason given why it cannot be. We are also out to oppose any despotic and un-American scheme by which we amateurs can be swept off the map by a brush of the hand whenever some unfriendly Government officer or committee takes a notion to do so. You fellows up and down the country must help. You must write your Congressmen and Senators and insist upon being reopened or given a reason why, and also upon legislation which will insure our existence in the future. Like the good Americans we are, let's SPEAK UP and require the other fellow to do the same.

STILL GOING UP

Things are moving fast, fellows. QST is a lot better each month. You don't have to tell us. We know it. You did it; your help made it possible. It is the measure of your co-operation which alone determines our progress. Keep it up.

Do you notice we are not advertising the Bonds any more? We are happy to say we don't have to. We didn't get the full amount authorized by our Board, but we got enough so that we can operate QST and steer clear of snags. To every loyal A.R.R.L. man who by his financial assistance helped to make this possible we extend the warm hand of good fellowship and congratulations.

But now don't get stuck up. We still need your help in certain other matters. We ask all hands to stop and think deeply a moment about dues and renewals.

Send in your renewals promptly when you are notified that your subscription has expired (unless, of course, there seems to be an error). You know you can't do without QST and that you are eventually going to renew so why make it necessary for us to blow A.R.R.L. money in sending you additional notices?

Another thing: Give us a hand and help establish QST on a news-stand in your town. It would not be good business for us to turn QST over to a national distributing agency, for by their methods there would be a few QST on every stand and we know by experience that one recognized place of sale in a small town is enough. We therefore want to distribute direct. Remember that to exactly the extent that QST is a business success, to just that extent will we here be able to give you a bigger and better magazine. See your newsdealer today and induce him to send in a trial order, and then tell the local amateurs where they can obtain it. Tell your dealer we will allow him credit for the return of unsold copies. But don't let there be any unsold copies. Take an interest in it. You're one of us—we're all in the same boat. It's yours as much as it's ours.

And now just before we drop this and go out to lunch (for we must eat no matter how busy we are) just a word about dues and answering your letters. Come on with your unpaid dues, those who have not attended to the matter. Finish the job and be a real A.R.R.L. man. It's getting to be a distinction in the radio world. Don't put it off and make it necessary to send out second and third notices.

And now about the other thing—answering letters:

Do you chaps realize what kind of a game this is here at headquarters? Well, hectic is the word. Between writing copy, soliciting advertising, running after the electrotyper, cussing the printer, and explaining to the little boy visitor why his kerflunkus detector won't work without a crystal in it, we are surely kept out of mischief. If we ever seem short in our letters, remember we don't intend to be. And remember too, we simply cannot answer all the letters we receive. It would keep seventeen of us busy. All we can say is that we appreciate the letters and would certainly answer every one if there were enough hours in a day. We never before realized to the full what A.R.R.L. spirit is. It just keeps you on the high gear all the time. It's just wonderful, and makes a fellow wonder if its like exists in any other line of endeavor.

There—it's all said. Now for those baked beans.

JUST BETWEEN US

Don't breathe a word of this—it's just among us friends.

Ever hear it said that imitation is the sincerest form of flattery? Well, we've been sincerely flattered, only it wouldn't do of course to mention it outside.

You know we have always had a couple of expressions all our own. We said our QST was a 100 percent amateur magazine and that it was "of, by, and for the amateur." Well, say, it has been copied. You must have noticed it. After using it for three years, don't it make you smile to see the new ones imitating us? And, after all, who is the only simon-pure "of the amateur, by the amateur, and for the amateur"? And what is the only organization of amateurs recognized by Uncle Samuel? Our A.R.R.L.—that's what!

IMPULSE EXCITATION

Wanted—QST readers who know or suspect anything about Impact Excitation, to come across and tell the rest of us about it.

As we see it, Impulse Excitation is a system of spark radio wherein the primary circuit discharges with a single violent kick, setting the aerial circuit into strong oscillation and then letting it oscillate at its own frequency without feedback and with a damping determined solely by the antenna circuit's resistance (ohmic plus radiation).

We have often wondered why some of the manufacturers never put out a standard amateur impact transmitter. It would seem to offer many advantages. If the primary can be made to discharge with a single impulse, analogous to a half-cycle, then it has no "oscillation constant" or "frequency", and obviously there is no necessity for resonance. This means that in the primary we may use a whale of a condenser—just as large as our transformer requires for maximum output, instead of being limited to a maximum of around .008 mfds., which is about the value for 200 meters. This certainly is along the lines we "short horns" must work, to get anywhere on our restricted wavelengths.

Considerable work along this line has been done in the development of commercial sets, but in none of these does true impulse excitation seem to have been attained, for it seems to be a fact that in them maximum output is secured when the primary has a natural period 1.7 times that of the secondary, showing that the primary is not really aperiodic. If it were, the period of the primary should be immaterial.

Now how can we short wavers obtain true impulse excitation? We know one thing: That in any circuit containing inductance and capacity, oscillations will not take place if the resistance exceeds a certain critical value. This is the main principle involved in this work. Experimentally it may be determined that the introduction of a graphite resistance in such a circuit changes the discharge from an oscillatory character to an aperiodic discharge. The energy consumed in the resistance is of course lost, making such a system extremely inefficient, but juice is cheap and we are willing to pay for distance. Results are being obtained experimentally with the use of special gaps using hydrocarbon vapors, so increasing the resistance to the discharge that the circuit cannot oscillate, or at most has only a very feeble swing after the first main impulse. It is interesting to note that this is merely carrying to an extreme the application of those principles which we know to be desirable to improve quenching in our non-synchronous rotary gaps. Another feature which may be utilized is the employment of a very large capacity and as small an inductance as practicable, which makes the circuit a very poor oscillator and in itself increases the decrement.

By comparing notes, who shall say that right here in the pages of our QST we may not be able to develop possibilities in 200-meter work of which we do not now dream? Think this over, some of you wise ones, and say something.

WE'RE ON

In August we asked for suggestions from our members as to what they would like to see in QST. We surely got the suggestions. You fellows just ought to see our mail. The suggestions are unanimous, and so:

We will resume our old Pictorial Section. It is going to be confined to after-the-war sets. You are invited to send in photographs and descriptions of your stations, for publication in QST.

When we get going again we will publish calls heard; but not until then. There is no value in publishing the reports of commercials heard, unless the circumstances are unusual or the distance covered a record. It's going to be rare fun publishing the lists of fellows copied, after we get open. That feature of our magazine helped us all tremendously in the olden days.

If we should be opened suddenly, between issues of QST, be sure to report your new call letters to us. It will probably be some time before a Government callbook listing amateur calls can be published, and we are going to find QST mighty convenient for letting the rest of the bunch know our sign-in.

In August we told you of our desire to publish an A.R.R.L. Honor Roll—to commemorate the deeds and perpetuate the memory of those of our fellow members and co-workers who hit the westward trail in the Big War. Have you done what you can to make this complete? If you can add any information, do not delay dropping us a line.

BUILDING YOUR OWN C. W. APPARATUS.

(Concluded from page 6)

could be devised, and other methods will suggest themselves to the builder.

When first testing out, if no results are obtained, do not be discouraged. Reverse the battery potentials until the correct way is found. Be sure the plate voltage is sufficiently high, as some bulbs require up to 60 volts. Make certain that all connections are tight, that the condensers do not short-circuit; and most important, reverse the tickler leads, as no oscillations can possibly occur should the tickler coil be connected wrong.

To tune, set the primary condenser at any point, then move the secondary condenser slowly back and forth until a decided click is heard in the phones, denoting that resonance has been reached and that the bulb is oscillating properly. If nothing is heard at this point, keep climbing along the scale with both condensers and you are certain to be rewarded with signals, as it is very seldom that there are not some CW transmitters operating.

This apparatus can be used, of course, with aerial and ground, but the beauty of the cage is its improved signal-to-static ratio, and with an amplifier the chances for getting actual copy are much better on the loop.

"NOT SO ROTTEN".

(Concluded on page 7)

Say—speaking of gaps reminds me of yaps. What's the matter down there in Washington, D. C.? Haven't they yapped enough by now and can't they give us a chance with our gaps? What ails the Navy Department any way? The Canadians were in the war, seems to me I have heard it said, and the amateurs up there are transmitting. Don't our folks know the war is over? Somebody send a postal to the Navy and let them know it was all over months ago. I am an American and I want my liberty the same as the Canadians have theirs.

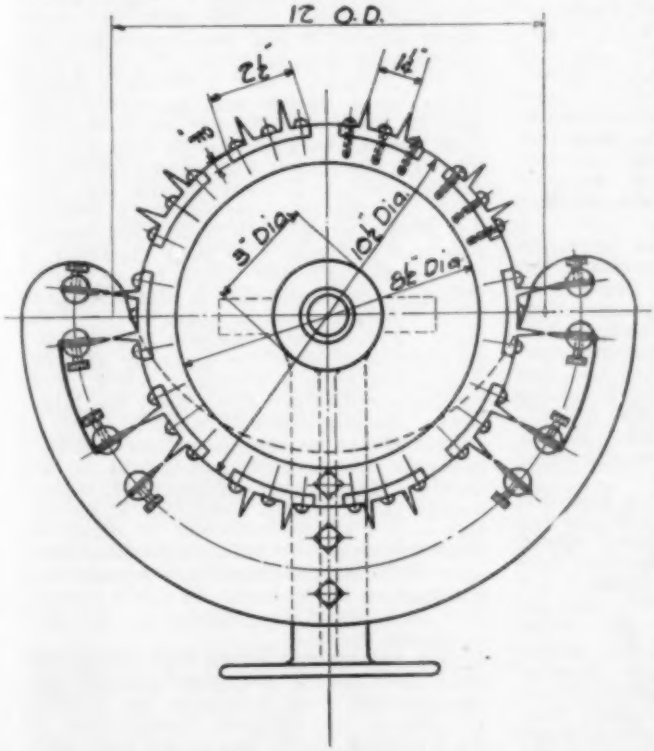
The Old Man

Efficient Short Wave Transmitters

By Guy E. Wilson

AS the problem of an efficient short wave transmitter occupies a prominent place in the minds of the majority of the advanced experimenters, the writer wishes to express his ideas on the subject. Inasmuch as C. W. transmitters for short waves are unreliable, inefficient, and very expensive, unless vacuum tubes are used, in which case the last objection still holds, only the spark transmitter will be considered here. It is quite probable that C. W. transmitters for amateurs will come in the not very distant future, but at present the spark transmitter will still hold its own.

It seems almost certain that transmitters



of the characteristics generally used before the war will not be permitted when transmitting is resumed, as undoubtedly the requirements of the law of August, 1912, will have to be adhered to far more closely than formerly. The decrement will have to be less than two-tenths, and the transmitters will not be allowed to use almost any old wavelength, so long as it isn't about 350 meters, as was the case before the war. Undoubtedly we will be carefully held to 200 meters, and if so, every bit of energy obtainable must be radiated in order that the long distance work formerly done may continue. In order to obtain the maximum antenna output, no detail of efficiency must be neglected.

As mathematics, other than the simplest, are taboo, many of the statements and figures arrived at here will have to be accepted without proof. Any up-to-date book on the theory of radio-telegraphy contains all the mathematics used in obtaining the results arrived at in this article. Details of tuning, and other matters which are commonly contained in text books, will be omitted. What the writer wishes to show is that a little practical experience mixed with theory will produce a set which is the equal of any in experimental use.

The first thing to be considered is the spark gap. Too much stress cannot be laid on the fact that the spark gap is mainly responsible for the success or failure of many stations. Let us first consider the material to be used in the rotor. In the writer's opinion, aluminum is the best metal to use. Although not as good a radiator of heat as copper, it possesses the advantage of lightness, a very important advantage when it is considered that the gap must rotate at a high speed. In the case of a heavy gap, the objections to a high speed are obvious. Another advantage of aluminum is that it is not burnt away as rapidly by the spark discharge as are copper and zinc.

A common error is the idea that the only function of the rotary gap is to produce a musical note. Another function of greater importance, and not generally recognized, can be made use of in the properly designed gap. I refer to the quenching action. It has been shown that if we can allow the closed circuit to

(Continued on page 20)

The Operating Department

J. O. Smith, Traffic Manager
Rockville Centre, L. I.

SUMMER has come and gone without any radical change in the amateur situation, and our stations are still silent. The August supplement of the United States radio call book, however, contains a short list of the Y class of stations that have been licensed, but information has developed the fact that although licenses have been issued and call letters assigned, transmitting by even these stations will not be permitted until the ban is lifted.

The old familiar newspaper stories of hearings on "Secretary Daniel's bill to give the Navy a monopoly of radio" are once more making their usual monthly appearance, and have caused many of us to wonder how much longer Secretary Daniels will be allowed to clog the legislative machinery of the country with his personal, pet theories, while thousands of radio amateurs are prohibited from exercising the privilege of operation of their stations.

We would not mind if there were any reason for this continued oppression, but repeated inquiries of the Navy Department by amateurs, Senators and Representatives have generally met with reply to the effect that Secretary Daniels was solely responsible for the continued restrictions and that no one else, not even Assistant Secretary Roosevelt, knew why the war-time restrictions had not been lifted. Possibly no one has informed the Honorable Secretary that the war is over.

It seems a sad state of affairs, however, when the personal desires of one man can offset the desires of ten thousand others, especially when the purpose involved is a perfectly legitimate and desirable one. The autocracy that so many of us left our homes and business ties to help crush seemingly was of no more a radical nature than the present amateur radio situation here in America, where one man is imposing his will by might on ten thousand other men and failing to give an American reason for it. That this un-American, autocratic attitude cannot long survive seems assured. It will help the cause of Americanism, help the cause of amateur radio and help put down incipient autocracy and intolerence if every man, woman and child who reads this will write at once to their Representatives and Senators and request that the war-time restrictions on amateur radio be immediately removed, so that amateur transmitting can be resumed, or a good AMERICAN reason be given why it can't be done.

Write now, and right now!

ATLANTIC DIVISION.

Chas. A. Service, Jr., Manager.
Bala, Pa.

Owing to the absence of the Atlantic Division Manager from his home for the last three weeks, spending a vacation in the Canadian woods, where mail and news travel slowly, it has been impossible for him to keep in direct touch with conditions in his Division. Mr. Entwistle's report shows much energy and activity on his part in mapping out very comprehensive relay routes and even though they are still tentative, they form a fine basis for future development. Activity among the Canadian amateurs is also of much interest and should bring forth fruit when we are able to co-operate with them; however, it is probable only the larger cities will be linked up with stations in the States, as many others are too far apart to bridge the gaps. The Atlantic Division Manager has recently been over the majority of Nova Scotia and from a wireless point of view, its opportunities are slim. Only the larger towns are supplied with electric light, no aerials are to be seen anywhere and it is probable this part of Canada will develop slowly. Mr. Lorimer, of Montreal, is thoroughly familiar with conditions in his section and a letter from him to either the Traffic Manager or Atlantic Division Manager outlining conditions and prospects of a Canadian route would be much appreciated and would be included in the QST operating reports.

It is to be sincerely hoped that by the time this report goes to print the Navy will have seen its way clear to remove the war-time restrictions on amateur transmitting, as no American reason has as yet been given as to why these restrictions should be continued.

ATLANTIC DIVISION.

(Southern District)
Chas H. Stewart, Ass't Division Manager,
St. David's, Penna.

Owing to the fact that this is the vacation season, and the ban is still on, there is

relatively little of interest to report at this time.

Mr. W. T. Gravely, District Supt. Central Virginia District, advises that he is particularly anxious to get into communication with radio men located in Richmond or vicinity who may take an interest in the work of the League, and it is suggested that anyone interested communicate with him at his present address, 503 Main Street, Danville, Va. Furthermore, he is anxious to get in touch with any radio enthusiasts located between Richmond and Danville and Richmond and Washington, as well as those located at other points in his State.

The desire to hear from those interested in the work of the League is not confined alone to Mr. Gravely, as the other District Superintendents in my District have also expressed themselves along the same lines. I would suggest that in the event that any interested parties do not know the address of their local District Superintendent, that their communications be forwarded to me at St. David's, Pa., and it will afford me much pleasure to see that they are properly forwarded to the respective District Superintendents.

Mr. E. B. Duvall, Superintendent for the Eastern Maryland District, wishes that it be made known that after September 1st, 1919, his address will be 4004 Park Heights Avenue, Baltimore Md., and requests that he be addressed accordingly in the future.

Owing to the temporary absence of the District Superintendent of the Central Pennsylvania District, Mr. W. M. Cawley, of Milton, Penna., I have at his request appointed Mr. Herbert M. Walleze, Assistant District Superintendent, during the absence of Mr. Cawley. It should be noted that communications for Mr. Walleze should be addressed to him at 234 Vine Street, Milton, Penna.

ATLANTIC DIVISION
(Northern Section).

Guy R. Entwistle, Ass't Division Manager, 137 Sutherland Road, Brookline, Mass.

While waiting for the actual removal of the ban on transmitting so we can actually tell who is who, etc., tentative routes have been laid out for the approval of the amateurs in the First District. They are by no means the final selection of cities or stations merely serving as a starting point for future development. If you are not included write to your nearest relay traffic official for assignment.

Mr. Albert C. Lorimer, 243 Mackay St., Montreal Quebec, Canada will be pleased to co-operate with American amateurs.

Mr. Lee Bostwick, The Ormond Block, Winnoski Ave., Burlington, Vt., will be glad to hear from amateurs in his district.

Mr. Harry McLean, Laconia, N.H., would like to hear from some of the boys up his way. Also Mr. R. F. Howe of Keene, New Hampshire.

Mr. Wilbur H. Hardy, District Supt. for Northern Mass. is anxious to line up the stations on the Boston to Portland—Rockland—Bangor—Bar Harbor—Eastport line. Write him your troubles.

We have already been negotiating with British amateurs and amateurs in the Azores for a proposed Transatlantic relay. What can you do to help us.

New England amateurs should all be preparing for the second annual banquet of the New England Amateur Wireless Assn. The Secretary, Mr. Wallace E. Heckman, 119 Windermere Road, Auburndale, Mass., will take advanced orders for reservations. Don't be left out when the time comes.

The Canadian amateurs are already transmitting and have calls similar to ours, beginning with 1 and 2. Please report any heard.

EAST GULF DIVISION.

John C. Cooper, Jr., Manager.
Atlantic National Bank Building
Jacksonville, Florida.

The East Gulf Division has been divided into three sections: The Carolina Section consisting of North and South Carolina, the Eastern Section to consist of Georgia, Florida and Alabama, the Western Section to consist of Arkansas, Mississippi, Louisiana and Tennessee.

CAROLINA SECTION. No Assistant Division Manager has yet been appointed for this section. It is earnestly requested that any amateurs who are interested in relay work in either North Carolina or South Carolina communicate with me immediately.

EASTERN SECTION. Mr. W. B. Pope, No. 197 Dearing Street, Athens, Ga. has been appointed Assistant Division Manager of the Eastern Section. Mr. Pope is one of the real veterans in the Southeast and we believe we are fortunate to have his services. His former license was 4AA, by which he was known throughout this part of the country. The following District Superintendents have already been appointed: Georgia, Mr. Philip C. Bangs, No. 29 Albemarle Ave., Atlanta, Ga.; District of South Florida, Mr. Houston Wall, c/o Knight Wall Co., Tampa, Fla. Mr. Wall's territory will include all of Florida south of the City of Jacksonville. Mr. Bangs, who has been appointed District Superintendent for Georgia, is President of the Atlantic Relay Club. He expects to have several good stations in operation in Atlanta next winter. It is also expected that

the Georgia School of Technology station, also in Atlanta, will be much improved and also used for Radio Relay work. Several former relay operators will be students at Ga. Tech. next year, including A. D. Whitaker, Jr. of Atlanta, formerly 4AP, and Je Ter Puckston of Valdosta, Ga., formerly 4BD. In Florida, Mr. Wall reports that he is already commencing work, trying to locate stations to open up the lines between Jacksonville and Tampa. It is expected that the new station being built at Ft. Pierce by O. A. Gullidge will be of much assistance. All operafors desiring to have their stations named as official relay stations should communicate either with the District Superintendent, or if no District Superintendent has yet been appointed for their territory, direct with the Division Manager.

WESTERN SECTION. Mr. John M. Clayton, No. 1301 Welch Street, Little Rock, Ark., Assistant Division Manager. Mr . Clayton reports the following official relay stations already opened:

P. E. Greenlaw, Franklinton, La.
D. R. Simmons, Shreveport, La.

University of Arkansas at Fayetteville, Arkansas.

He is also in communication with the University of Mississippi and hopes to be able to recommend at an early date that station as an official relay station for that part of Miss. Mr. Greenlaw and Mr. Simmons above mentioned have been appointed as District Superintendents in Louisiana and amateurs in their territory should communicate with them. No District Superintendents have been appointed in Miss. or Tenn. and amateurs in those states as well as in Ark. are again urged to communicate with Mr. Clayton. He also reports that he has gotten in touch with the division managers of the Central Division and of the West Gulf Division, with reference to arrangements for handling traffic lines "C" and "E" through the western section of the East Gulf Division. No definite arrangements have yet been made but progress is reported. On line "E" it is expected that work can be handled satisfactorily from 9VP to Little Rock, from Little Rock to Shreveport and from Shreveport to Franklinton. Efforts are being made to locate a station near New Orleans, 30 or 40 miles distant from that City, so that some of the prospective stations in New Orleans can work with that station on low power as it seems that New Orleans amateur stations have heretofore had trouble on account of interference with commercial and Government stations in New Orleans. On line "C" it is expected that Franklinton can work direct with 5ED at Houston, Texas and thus connect the East Gulf and West Gulf Divisions on that trunk line.

WEST GULF DIVISION,
F. M. Corlett, Manager,
1101 East Eighth Street, Dallas, Texas.

Isn't it great to be home again? I'll say it is! I know that there are a great many more fellows wishing that they were at home and I certainly hope that their wish becomes a reality for I know that you are anxious to pull the old table out of the plunder room, knock about a ton of dirt and dust off the old apparatus, 'n,—well everyone knows what comes next. That is what I have been doing the last few days and unless something unexpected happens old 5ZC apparatus will be ready when the transmitting ban is finally lifted. No doubt but what there are a good number of you returning to this and other Divisions every day. Of course there is a world of things to be attended to and you can't get around to all of them at once, but LISTEN FELLOWS, DON'T put off getting straight with the A.R.R.L. If you haven't an application blank write for one but by all means send in your annual dues. Make your Money Order payable to the Secretary, A.R.R.L., Inc., Hartford, Conn., send it to your District Superintendent or Assistant District Superintendent, together with the application blank properly filled out and he will forward it. If you are already paid up for the year let your District Superintendent know that you are home again; if you don't know who your Dist. Supt. is, write the Division Manager direct.

It is the Division Manager's intention to subdivide the various Districts into Territories, appointing an Assistant District Superintendent for each, and in the larger cities where a number of stations are sure to be found, a City Manager will be appointed.

The following appointments have been made; Mr. Raymond L. White, P. O. Box, 322, Ennis, Texas, as Assistant District Superintendent, Northern Texas District, and has been assigned the TERRITORY of Ellis, Hill, and Navarro Counties, the same to be known as theENNIS, TEXAS, TERRITORY. Mr. W. H. Tilley, P. O. Box 663, Austin, Texas, as Assistant District Superintendent, Southern Texas District, and assigned the TERRITORY of Travis, Williamson, Burnet, Blanco, Hays, Caldwell and Bastrop Counties, same to be known as the AUSTIN, TEXAS, TERRITORY.

The appearance of QST certainly is bringing in results; every day brings more correspondence and reveals the location of the "old timers" as well as bringing to light a number of new stations under construction or plans concerning them.

The Traffic Manager, in designating relay routes, has favored this division with two routes, Line "C" from Jacksonville, Fla., to Los Angeles, Calif., and Line "F" from Grand Forks, N.D., to Dallas, Texas. Line

"C" will cross Texas, New Mexico and Arizona. Line "F" will cross part of Northern Texas District, and the District of Oklahoma. The exact routes of each line will of course depend upon the locations of the various relay stations. It is going to take quite a number of relay stations to bridge the gaps between these points and that means there will be lots of room for all the dependable, live awake, up-to-date amateurs, so you had better lose very little time in getting in touch with your respective District Superintendents, telling him what your set consists of and what improvements you intend making.

PACIFIC DIVISION.

Seefred Brothers, Managers,
343 So. Fremont Ave., Los Angeles, Calif.

Mr. George W. Cameron, 500 East 12th Street, Portland, Oregon, is appointed as District Superintendent for the Northwest District. He reports that amateurs around his district will not be ready for any relay work before the first of September, as most of the fellows are out of town at the present time.

Mr. Fred Terman of Stanford University, Calif., is appointed as District Superintendent for the Central District. He reports that radio stations 6AU, 6KU, JS, 6AHN, 6AG, and 6FK (formerly of Santa Monica, but now of Palo Alto), are ready to start up when the ban is lifted. Nothing has been heard from 6WZ, 6BY, 6WC, 6AAV, 6WG, 6NL, 6AV, and 6HO. Most of the old fellows are still in the navy as radio electricians. He also reports that on his receiving outfit he has copied NPS (2000 miles), KEFR (S.S. Ossining, 1450 miles south), VAE, VAG, and ships up to 1000 miles away.

Mr. H. L. Newnan, 2242 San Jose Avenue, Alameda, Calif., is appointed as assistant Manager of the Pacific Coast Division. He also says that Fresno will be on the relay map for a relay station between Los Angeles and San Francisco, but he thinks that Bakersfield will make a better relay point for this purpose.

The amateurs of Los Angeles and vicinity, as well as San Diego, are not much in evidence as yet, except several new fellows who are just starting in the game. As soon as restrictions on transmitting are removed, we expect to give a better line-up of the stations on this coast.

We are contemplating a trip up north to San Francisco and the Bay cities, to visit all radio relay stations there, and also to line things up with our two District Superintendents. We plan to have a much better radio station by next winter than we had in the pre-war days, and hope to break all our former transmission and reception records.

We would like to hear from all the old timers, as well as the new ones, who wish to be on the relay routes on this coast, and we hope that after things get started that the American Radio Relay League will have an even better relay system than we had before the war.

We also are very glad to see our QST once again, and we want everybody to become a member and subscribe to QST, the **only** amateur magazine in this country.

PACIFIC DIVISION, (Western Ssction).

H. L. Newnan, Ass't Division Manager,
2242 San Jose Ave., Alameda, Calif.

The radio relay system through the Pacific Division seems very hopeful for the coming season. Many of the boys who got the "biz" thru before the war are still in the naval service, but we are working on the development of trunk lines "B", "E", and "F".

The situation in San Francisco is not very encouraging due to the remote control station at NWO which controls three stations in San Francisco. As soon as the navy gives up the control of commercial traffic there will be a little more system here and less QRM. It is probably the same as NAH in New York.

F. Terman is the District Superintendent for San Francisco. We are planning to run Trunk Line "B" from San Francisco via Berkeley, Walnut Grove, Sacramento, Reno, Nev., and then let Andelin of the Mountain Division handle it from Reno East. There are no stations in Nevada east of Reno. Trunk line "F" will run south from San Francisco via 6FT, Terman, at Palo Alto, San Jose, probably Fresno and on to Los Angeles then on through Phoenix, Arizona, and east via Denver or Texas stations. There seem to be no stations in New Mexico. It's about time someone wakes up down there.

ROCKY MOUNTAIN DIVISION.

M. S. Andelin, Manager.
120 Canyon Road, Salt Lake City, Utah.

Organization has gone ahead in the division during the past month, but the traffic officers are handicapped in their plans because of some difficulty in locating station owners in Montana and Idaho. Amateurs in these States are requested to communicate with me immediately, so that a traffic organization may be perfected and trunk lines laid out previous to the reopening of transmission.

Efficient Short Wave Transmitters

(Continued from page 15)

oscillate just long enough to set the open or antenna circuit into full oscillation, and then open the closed circuit before the open circuit can react on it, the antenna will oscillate at a single frequency, and consequently closer coupling can be used, with a consequent greater transfer of energy. From one to four oscillations in the closed circuit are sufficient to set the antenna into full oscillation.

If the rotary gap is to have this function of quenching, the rotary and stationary electrodes must be opposite each other just long enough for four oscillations to take place, when the increasing distance between the electrodes will break the spark, allowing the antenna to oscillate at a single frequency.

At 200 meters, four complete oscillations take place in

$$\frac{4 \times 200}{300{,}000{,}000} = .0000026 \text{ second.}$$

Let us assume that the electrodes, both stationary and rotary, are as narrow as possible, say .01 inch. In order that these may not be opposite each other more than .0000026 second a peripheral speed of

$$\frac{.01}{.0000026} = 3750$$

inches per second is necessary. On the basis of a 12 inch wheel a speed of

$$\frac{3750}{12 \times 3.1416} \times 60 = 6000$$

R. P. M. is necessary. At this speed 10 teeth will give 1000 sparks per second, or a 500 cycle note. The face of the wheel must be quite wide so as to allow sufficient sparking area to withstand the heat developed in the spark without burning. This width should be 1½ or better, 2 inches. This will require an accurately milled wheel in order that sparking may take place evenly across the entire face of the wheel. Four stationary electrodes should be provided if possible, in order that the condenser and oscillation transformer may be placed on opposite sides of the gap, shortening the leads and providing 4 gaps in series, which will decrease the tendency of the spark to jump forward to meet the rotary electrodes and thus defeat the object of this wheel.

If four gaps are used, a solid metal rim cannot be used. One method is to provide ten pairs of metallically connected teeth, so that a pair of stationary electrodes may be placed on diametrically opposite faces of the wheel, and a spark will occur when the two connected rotary electrodes are opposite the pair of stationary electrodes. The other method is to use a wheel having a face sufficiently wide to allow two stationary electrodes to be placed opposite the wheel side by side. This would involve an extremely wide face and is hardly practicable. The old method of allowing plugs to project through both faces of an insulating disc cannot be used unless the plug is replaced by a long narrow radial lug, in which case the constructional difficulties and the improbability of all the lugs being exactly radial make this scheme doubtful. In any construction, a provision for a slight movement of one set of stationary electrodes, circumferentially, will be of much value in obtaining an adjustment where the leading spark will be minimized.

Constructional details all narrow down to the few facts that the teeth must be extremely narrow in the direction of rotation, quite wide across the face of the wheel, must have a height of from ½ to ¾ of an inch, that the peripheral speed must be extremely high and that four gaps in series are extremely important. It goes without saying that the wheel must be accurately milled and run quite true.

A gap designed by the writer to embody the foregoing features is illustrated in the figure. It is milled from an aluminum blank, 12 inches outside diameter and 1½ inches thick. Ten pairs of teeth, 1¼ inches apart and ¾ inch high, are milled into this blank, and it is then turned into a ring, 9¾ inches inside diameter and cut into ten pieces 2½ inches long, each piece having one pair of teeth. A fibre or bakelite disc, of 1½ inch stock, is then turned up with an outside diameter of 10½ inches. It has a 3-inch-diameter hub and a 1-inch-wide rim that are the full 1½ inches thick, and a web ⅜ inch thick between the two. The rim is recessed as shown and the aluminum pieces are set in and fastened in place by six 8-32 machine screws—a necessity, as the centrifugal force acting on each piece is about 400 pounds, assuming each piece to weigh one ounce. After these pieces are in place the whole disc is mounted on the shaft of a 10-inch buffing stand, the hub being previously fitted with a brass bushing for mounting. The teeth should then be carefully finished on the new center, and the wheel balanced very carefully.

The stationary electrodes are of 1½ x ⅛ inch aluminum or copper, shaped as shown, and set in slots cut in ¾-inch round posts. The ribbon for connections is also placed in this slot, and the two held

in place by set screws. Eight electrodes are provided, which cuts the voltage to 2500 per gap. The condenser is connected to the lower posts on either side, and the oscillation transformer to the upper two. The other two on each side are connected together as shown. The posts for holding the stationary electrodes are mounted on a piece of ⅜ inch fibre or bakelite, which is fastened to the column of the buffing stand. All electrodes, both fixed and rotary, should be cut nearly to a knife edge.

The condenser is next in importance. A great amount of energy is often wasted in the condenser. Compressed air condensers are the most efficient, but their great size and weight preclude the thought of their being used in an amateur set. The most practical condenser is the oil immersed plate glass condenser. Photographic plates are best for the dielectric, as they are of exceptional quality, and their dielectric constant is from 6 to 8. These plates generally come in two thicknesses, .05 and .10 of an inch. As at least $\frac{3}{16}$ inch of thickness is necessary to prevent puncturing the plate, two of the .10 or three of the .05 inch plates should be used between the metallic sheets.

These are best of sheet brass or copper, as tinfoil is easily torn, burns up, and is otherwise unsatisfactory. Lugs should be cut which are continuous with the plate and extend beyond the edges of the glass plates for connection purposes. All corners should be rounded to a fairly large radius and at least a one inch space left between the edge of the metal and the edge of the glass. The condenser must be immersed in oil, or heavy losses cannot be prevented. Very efficient condenser units, which are impregnated in an insulating compound, and have a mica dielectric, have been developed during the war, but their cost is so great it is hardly probable that they will be available for general amateur use.

The relation between the secondary voltage, power, condenser capacity, and spark frequency, is

$$C = \frac{P}{E^2 N}$$

where C is the capacity of the condenser, P is the Power, E the voltage to which the condenser is charged, N the spark train frequency in cycles (not the number of sparks). Assuming that we have 1000 watts in the secondary circuit, and that the secondary voltage is 20,000, the capacity

$$C = \frac{1{,}000}{400{,}000{,}000 \times 500} = \frac{1}{200{,}000{,}000}$$

farad, or .005 mfd.

The condenser as above determined will be of such a capacity that it will be charged to a potential difference equal to that of the secondary of the transformer, in the period between trains. As high a potential as 20,000 volts, even though divided between four gaps, may cause the spark to jump forward to meet the rotary electrodes and allow the condenser to discharge over a longer period than is desired. It may be necessary for this reason to use a somewhat greater capacity than .005 mfd., but this is just as well, as the wattage drawn by a slightly larger condenser charged to a somewhat lower voltage will be about the same, and the natural damping of the primary circuit will be increased by such a change in the LC proportions. With a judicious increase in capacity, as determined by experiment, the use of four gaps and the circumferential adjustment of one set of the stationary electrodes will reduce the tendency of the leading spark to a minimum.

The oscillation transformer should be of the pancake type as this type occupies a minimum of space. The ribbon used should be as wide as possible, not less than 1 inch, and preferably 1½ or 2. The thickness is of slight importance. The writer knows of one extremely efficient oscillation transformer in which 1 inch solid ribbon was used to support a 1 inch copper braided ribbon, reducing the high frequency resistance to a minimum. This oscillation transformer never heated, while a similar one on a similar set, using the solid ribbon alone, was warmed appreciably after a very short period of transmitting.

The ribbon should be supported on bakelite, rubber or fibre strips. Wood should never be used in this capacity. Rubber or bakelite is preferable to fiber, as the latter absorbs moisture and is apt to warp.

If a capacity of .005 mfds. is used, an inductance of 2250 centimeters is necessary for 200 meters. Remembering that the product of LC for 200 meters is 11.26, the inductance can be easily determined for any other capacity.

All leads in the oscillatory circuit should be of heavy braided ribbon to decrease the high frequency resistance. They must also be as short as possible, in order to concentrate all of the inductance in the oscillation transformer, and make possible a more effcient transfer of energy to the antenna circuit. The secondary of the O. T. will, in general, have a somewhat larger value of inductance, say 3000 to 4000 centimeters.

The transformer should be of an efficient type, and it is generally conceded that better transformers can be bought than made. Care should be taken that the power factor is not allowed to become so low that the transformer fails to draw

its full power. Another factor causing failure to get full power is the voltage drop due to the heavy current. The transformer, if possible, should be placed on a power circuit where the leads are heavy, and as close to the source of supply as possible.

A kick-back preventer should be used. The type consisting of 2 condensers in series across the line with the connection between the condensers grounded, is the simplest, and as good as any. It is also good practice to place in each lead, from the secondary of the transformer to the condenser, a choke coil consisting of 15 or 20 turns of wire, in a coil about 2½ inches in diameter. These will prevent any high frequency surges from the condenser entering the secondary.

Antennae and grounds have been thoroughly covered in other articles in QST, so we will content ourselves with insisting that the antenna lead shall be as direct as possible, be well insulated, and kept well away from any grounded object. The ground lead should be very heavy and run as directly as possible to a good ground.

The practice of carefully insulating the ground-lead is wasted effort. There is extremely little, if any, justification for its insulation. The labor should be expended in carefully arranging the connecting leads of the primary circuit so that they do not touch the wood or oilcloth, etc., of the table.

In order to be sure the wave length is not more than 200 meters, and that only one wave is radiated, a wave meter is necessary. The type having a current squared meter is preferable, in order that a curve may be plotted showing the sharpness and strength of all waves radiated and in order that the logarithmic decrement may be determined. The method of tuning with a hot-wire ammeter is not satisfactory, and is apt to lead to broad tuning rather than sharp tuning. It is quite probable that if the set is tuned with a wave meter and only a single wave radiated, more energy will be radiated on one wavelength even though the hot-wire ammeter reading may be less. Wavemeter tuning is explained in detail in any up-to-date book on radio.

If undue stress seems to have been laid on the gap, it must be remembered that the writer believes that in this piece of apparatus is the secret of sucess or failure, and no pains should be spared in its construction.

The Connecticut Tube

A NEW and interesting type of vacuum tube has been developed by Mr. H. P. Donle, Radio Engineer of the Connecticut Telephone & Electric Co., Meriden, Conn., which not only departs entirely from previous usage but operates by means of what is believed to be a new effect: electrolytic conduction in a hot dielectric.

The easiest way to grasp the fundamentals of the new tube is to study Fig. 1, where the structure is shown diagrammatically, F being the filament, C the grid surrounding the filament, both contained within the evacuated glass chamber T, and A the anode or plate consisting of a metallic coating applied directly to the outer glass surface. The tube is used in the conventional manner, the electrode A being connected to the positive terminal of the B battery, the negative terminal going to the filament and the headset being included in the circuit. The tube is exhausted to the highest obtainable vacuum and the operation is thermionic; i.e., purely by electron emission.

The point of immediate interest is the passage of the plate current thru the glass. Glass has up to the present been looked upon as at least a fair insulator, altho it has been known that at or near the melting point it becomes a good conductor. Obviously, however, it is absolutely impossible to operate a vacuum tube at such a temperature, as glass does not begin to soften until heated to about 425 degrees C. In contact with certain elements, however, glass becomes a good conductor at a far lower temperature than this; but the conduction thru it when in this condition is purely electrolytic, and all the phenomena accompanying conduction thru a liquid electrolyte are present in hot glass, such as decomposition, polarization, etc. During the development work, conductivity tests were carried out with many various elements, but with most of them an apparent polarization took place at the contact with the glass which

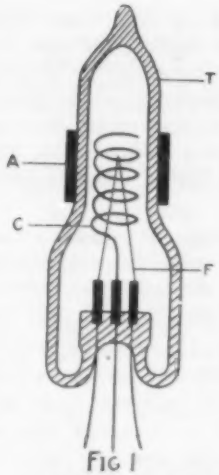


FIG 1

greatly increased the resistance instead of giving the results sought. It was discovered that when silver was the anode terminal, however, this action was almost entirely absent; so much so that at the proper temperature the glass became a very fair conductor.

It might be supposed that the electrolytic disassociation of the glass walls would make it impracticable to construct a tube in this manner, but the inventor assures us it has been found feasible to so distribute the current density that disassociation takes place at a very slow rate so that glass life will be one of the smallest factors in the life of the tube.

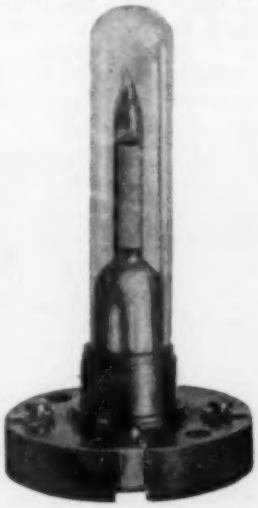
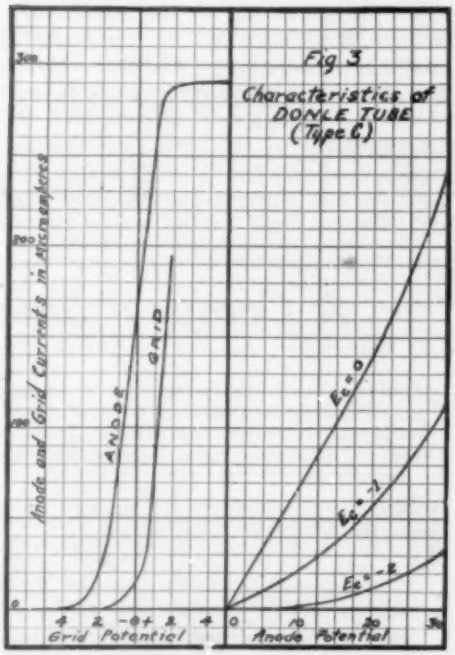


Fig. 2

Several types of tubes have been designed, working on this conductive property of heated glass, the glass being heated to the required degree by the filament (which of course also supplies the electrons) and maintained at the proper temperature by enclosing the tube within an outer shell of glass, provided with vents at its lower end in order that the temperature will not exceed its proper value. Fig. 2 illustrates the Type C tube, a detector operating on 20 volts anode potential, and probably the type of greatest interest to the amateur.



The construction needs very little description. The entire inner structure with the exception of the supporting wires is tungsten and molybdenum. The glass tube is drawn to a smaller diameter immediately over the filament and coated on the outside of that portion with silver, to form the "plate". Notice that the vacuum chamber is extremely small, in fact proportioned like a medicine-dropper, reducing the internal impedance but being utilized primarily so as to efficiently heat the glass wall from the incandescent filament.

In Fig. 3 is shown the grid voltage—

plate current characteristic curve (also the grid current curve) and three plate voltage—plate current curves for various grid potentials. The grid control characteristic shows one very peculiar feature: a sudden and definite saturation at a point near zero grid potential. The cause of this is readily explained.

In this tube we have in reality two resistances, that from filament to inner wall of the tube and that of the glass wall itself. This latter is nearly a fixed value determined largely by the glass temperature, but the former depends entirely upon the potential of the grid. It is obvious therefore that as we make the grid more positive, we decrease this former resistance until we reach a point where it is inappreciable compared with the resistance of the glass, and therefore in this condition the latter is the controlling factor in current flow between anode and filament, and so the curve abruptly flattens out. It has been found possible to shift the position of this bend to any desired grid potential by altering the filament dimensions so as to change the ratio of electronic emission to glass temperature, and the values shown in the C tube were found best for a tube designed for this work.

While designed primarily as detectors, the Type C tube in particular has proved a very effective amplifier, its Mu or amplification constant having been measured at slightly over 19, which is much higher than obtains in the orthodox tubes. As detectors they seem to operate quite satisfactorily with either a stopping condenser or a polarized grid, and are said to have exceptional oscillating qualities, making them particularly adapted for use in regenerative or oscillating receivers. Considered all around, the Connecticut tube is a most interesting and promising development.

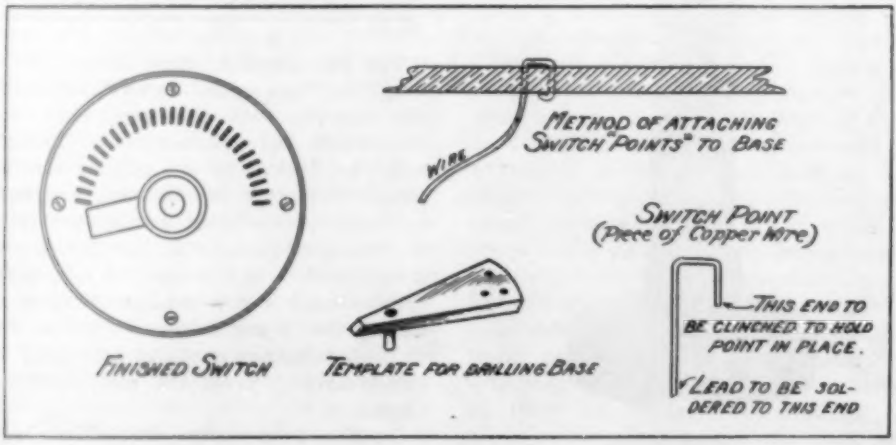
A Compact Small-Capacity Switch

By Chas. E. Pearce

Mr. Pearce presents a most novel idea for the construction of multi-point switches. It seems remarkable (now that we see it) that it has not been used long before. It surely takes an amateur to produce something like this.—Editor

For use where a large number of switch-points are required in a small space, or where regular switch-points may be either financially or geographically out of reach, this switch is recommended. Forty eight points may be put in a two inch circle, with as much or more separation between points as is usually allowed. Also these points have a very low capacity effect, which is of importance in audion circuits.

The template is made of a rather thick


METHOD OF ATTACHING SWITCH POINTS TO BASE
WIRE
SWITCH POINT (Piece of Copper Wire)
THIS END TO BE CLINCHED TO HOLD POINT IN PLACE.
LEAD TO BE SOLDERED TO THIS END
FINISHED SWITCH
TEMPLATE FOR DRILLING BASE

piece of any metal. The stud for the central hole of the switch is soldered. In making a switch the central hole is drilled first, and this stud inserted in it; the left hand hole (for the first point of the switch) is drilled, and a pin, such as a phonograph needle, inserted in it, to hold the template steady while the two right hand holes are drilled. Then the template is moved back until the pin in the outer right hand hole holds the plate steady for drilling the inner right hand hole, and the switch is begun. After drilling each pair, the plate is moved forward until the pin in the left hand hole, falls into the outer hole of the pair just drilled, until a sufficient number have been made.

TWIST DRILL SIZES

For	No.	14	wire, use	a	No. 51	drill
For	No.	16	wire, use	a	No. 55	drill
For	No.	18	wire, use	a	No. 58	drill
For	No.	20	wire, use	a	No. 66	drill

Carefully made, this switch is very neat and efficient; enamelled wire may be used for the "points", retaining the advantage of such insulation except on the top of the "point" where it may be cleaned off with emery or sand paper, after the switch is finished.

Connections are easily soldered to the end of the wire extending below the base, which may be left of any length desired. Any switch lever that will work over the regular points will work over these.

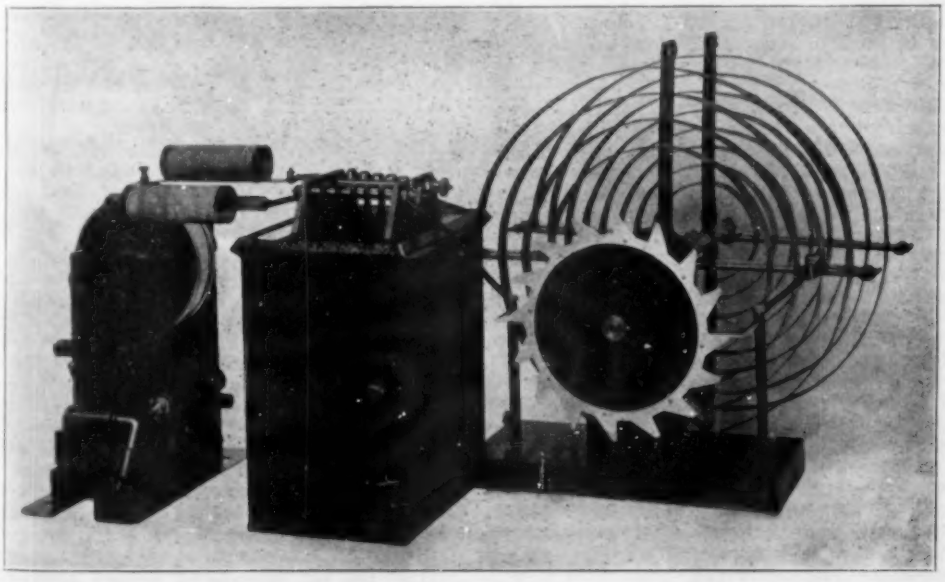
New Transmitting Apparatus

The Thordarson people seem willing to help us knock down the prize for their 1500-mile transmitting contest—they've brought out a complete set of transmitting apparatus to accompany their transformers, as shown in our illustration.

Being designed to work as a harmonious whole, the style is uniform and the instruments so arranged as to secure simplicity in connections and accessibility for adjustment.

The condenser is the most novel feature, and seems to have much merit. The dielectric is phenol fibre, otherwise "Bakelite", and as it withstands 45,000 volts without puncture, it should afford a sense of security to the operator of the 25,000 volt transformer. Sheet brass is used for the electrodes, with an extra sheet, corrugated, between the electrodes of adjacent units, so that when the whole is immersed in oil to conserve energy otherwise lost in brush discharge, heat, etc., the oil may circulate between each sheet of dielectric, thoroughly cooling the whole condenser. Ten terminals are provided, one from each plate, and it is interesting to note that the capacity may be varied

(Concluded on page 32)



Radio Communications by the Amateurs

The Publishers of QST assume no responsibility for the statements made herein by correspondents.

FROM MR. GAWLER.

WE have the following interesting letter from the New England Radio Inspector. Mr. Gawler has had years of experience with Radio Amateurs, and we value his expressions. This letter interests us all, and is just one more argument for the need of co-operative organization.

"Gentlemen:

The August 1919 QST arrived today and it is the first copy I have seen since your staff knocked off to go soldering. It is very gratifying to me to see Amateur Radio squaring away for another cruise.

"Droves of amateurs have asked me what might be summed up in the question, 'What is the future of Amateur Radio?' Amateur Radio in the future is going to be so well organized and regulated by the Amateur Radio Experimenter himself the Government will need spend but little energy or money in its administration. Do you realize that these "kids" responding to the call for radio men in the Army and Navy, or in other lines of military activity, have grown up and are no longer "kids" dabbling in home made, wooden radio apparatus? Do you realize the change effected in their process of thinking after about two weeks under military jurisdiction? Do you realize that all of this change began more than two years ago and that the greater percentage of our "kids" saw foreign service? Are these men, having done their bit with bakelite sets going back to the wooden sets of their childhood in the radio game? No, they are not! They are going to have bakelite amateur radio activity. Wooden operators, wooden apparatus, and anything else wooden in the game, will either be taboo, or else be made to look like the real thing, and the kids of yesterday will accomplish these results by their influence much better than the laws would.

"We had just begun to realize in this District a group of well organized radio stations, thanks to the A.R.R.L. and the other smaller radio clubs, when the war caused the closing of all stations other than Government stations. The splendid manner in which the amateurs responded to the call, and their state of preparedness to do good work at once, is evidence enough of their military value.

"The amateurs cannot afford to neglect organization because only through well organized efforts can the best results be obtained. The better this organization is maintained the greater will be the benefits derived by the Government.

"I have been complimented for what appeared to be good control over the amateur field in New England when the Navy needed operators in early 1917. The various radio clubs and associations in this District deserve the credit for snappy response, and most of all the A.R.R.L.

"Don't worry about what the Government is going to do about Amateur Radio Activity. The Government knew what to do about it when they needed radio men, and they are wiser today in this particular respect than they ever were before. Organize and improve your product so that the Government cannot afford to keep you closed up for transmitting, and so they cannot afford to enact laws restricting your scope of activities.

"I am enclosing my subscription. I don't know as it has expired but all machinery needs fuel.

"The results your patriotic efforts of preparedness produced during this war should be a great source of satisfaction and pleasure to you all, and I heartily congratulate you.

"With my best personal regards, I am,

Sincerely yours,

H. C. Gawler.

U.S. Radio Inspector, New England District".

SPARK COIL DOPE.

To the Editor of QST:

I noticed in the September number that a call was sent out for data on a scientific spark coil set. That is a step in the right direction. The spark coil cannot be bullied out of existance, and the "small boy" you speak of certainly will welcome any technical assistance which will show him how to improve his set.

One possibility which I think most amateurs have overlooked is that of operating their transmitters over a variety of wavelengths. Why not build our panels so that we can send on 100, 150, and 200 meters? This would mean a series condenser in the aerial for the lowest wave, and some re-

duction of signal strength, but for communication over short distances in sections where QRM prevails, the arrangement presents attractive features. A complicated wave-changing switch is not absolutely necessary—simple markers on the O.T. or helix for the positions to which the clips must be moved for a given tune should do the trick, if the condenser in the primary is not too large. On spark coil sets, however, small condensers must be used, so practically all of these tuning operations could be carried out by variation of inductance alone.

I do wish that some kind soul would put an interrupter of some kind on the market which would give something like satisfactory service. I believe it should be of the magnetic type, for commutator and mercury interrupters are too expensive for general use, and electrolytic interrupters interrupt the lighting circuits more than anything else. Protection from sparking across the magnetic type of vibrator by a simple condenser seems rather inadequate and crude. Why not some form of miniature kickback preventer as well?

Yours truly,

Sumner B. Young.

"Rosemont", Duxbury, Mass. Ex—1CO

ABOUT THE BRITISH ULTRAUDION.

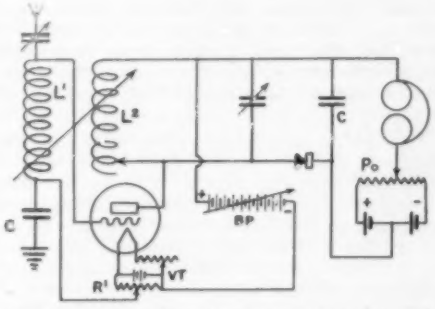
Lt. W. Klaus, U. S. N., O. I. C. Transatlantic Radio Control Station, Washington, sends us the following interesting comment by way of throwing light on a recent circuit published in QST.

"In reference to the hook-up on page 6 of the July issue of QST and of which I enclose a rough sketch modified slightly with the addition of a potentiometer, I will say, as you have invited comments, that I have used this hook up for about six months and have found it to be very good.

"This hookup has been known to the British Navy for about two years and altho they do not consider it one of their standard hookups they use it a good deal.

"A few of the peculiarities and constants of the circuit are herewith mentioned: This hookup will oscillate on every wavelength from 150 meters up to 4500 meters and with the addition of a condenser across the B battery up to 7000 meters.

The condenser C should be very large, anywhere from ½ to 2 mfds. This has no effect on the tuning of the primary circuit. This condenser, however can be dispensed with if a battery is used to supply the B potential. If the house voltage mains are used for the B potential this condenser is necessary. R_1 is 500 ohms. The adjustment of this resistance is very critical. One side of the critical point will cause the set to howl and the set will not oscillate on the other side of the critical point. The potential of BP of course is dependent on the bulb. C_1 is the usual stopping condenser. A peculiar feature of the set is that it will amplify spark signals without destroying the musical note providing the detector is adjusted and R_1 adjusted to the dead side of the critical point. The circuit works best with a carborundum detector and a potentiometer. This potentiometer should be 250 ohms and connected as per sketch to facilitate the changing of the direction of the current thru the detector crystal. The circuit has been called the oscillating-amplifying-detector hookup as it is readily seen that the functions of these three hookups are carried out in one.



"This hookup has been found to be quite selective. This is probably due to the phase action in the loose coupler which also acts as the feed back tickler. Any slight difference in frequency caused by detuning of either circuit throws the phase relation out and consequently the regenerative effect and the transfer of energy to the secondary circuit is much lessened. The coupling and tuning is therefore very critical.

"Incidently this circuit is somewhat of a radiator. Using one of the ordinary type 933 W. E. Co. receiving valves and placing a telegraph key in series with the source of B potential, C.W. signals have been transmitted up to a distance of two miles."

A FURTHER DISCUSSION ON NON-SYNCHRONOUS ROTARIES.

To the Editor of QST:

More losses occur at the spark gap than in the remainder of the closed oscillatory circuit combined, so it is evident that this is the piece of apparatus that deserves most of our attention toward improvement. I am sure that hundreds of other private experimenters shared, with myself, the interest and enjoyment of the article in the September issue of QST, on "Non-Synchronous Rotaries". This article is the expression of a subject to which I have given a great deal of thought and experimenting. I will take this opportunity to set down,

as a continuation of the September article, a few conclusions resulting from my endeavors, in hope that they will be of benefit to my fellow experimenters.

The mentioned article described a non-synchronous rotary gap that was mechanically quenched by proportioning the speed of rotation and diameter of the rotor, and width of the electrode sparking surfaces, to the natural frequency of the closed circuit. The ideal gap is one that will have infinite resistance on the charging of the condenser and no resistance during the discharge. These properties were accomplished to a high degree, as the gap possessed the necessary infinite resistance during charge and a very low resistance was obtained during discharge due to the very small clearance between sparking electrodes. The very fact that this clearance is so minute raises another difficulty in our path, and this is one of the subjects I wish to set forth.

The principal losses of a gap may be summed up as heat, light and sound. Reducing the gap length will result in a reduction of the slight losses resulting from light and sound, but greater heating of the electrodes will be experienced. This heating can be reduced by the use of certain materials for the electrodes.

The damping of a circuit depends upon the proportions of inductance and capacity of that circuit, and its ohmic resistance. When a spark gap is inserted in the circuit, this damping factor is changed, the amount depending upon the gap material. Silver or copper electrodes cause a change in the natural damping of about 10 per cent, while with zinc or pure tin only a change of a fraction of one per cent is experienced. Aluminum is a compromise between the two. It is therefore seen that certain metals have a greater choking effect on the oscillations than others. This choking effect or damping results from the resistance due to the relative heating of the various metals. We can now see why silver and copper are used in the ordinary quenched gap. But, the quenching effect is obtained at the expense of large heat losses, so large in fact, that the British Government for one condemns the use of this form of quenching. Now as we get our quenching effect by mechanical means in our non-synchronous rotary, quenching by means of certain electrodes is unnecessary and only adds to our losses. My advice, therefore, to experimenters is to use only zinc or pure tin for your sparking electrodes and I think you will find an appreciable gain in efficiency. The zinc will be found to wear slightly but its advantages will more than compensate for an occasional adjustment.

The author of "Non-Synchronous Rotaries" writes of trouble with a leading spark. I experienced the same trouble, but used a different method for its partial elimination. In order to make clear the method I used, I must first give a short explanation of the distribution of potential and current through an oscillatory circuit.

If we have a horizontal wire divided in the center by an air gap, we have the simplest form of open oscillator. If a spark jumps the gap, we have an electromagnetic oscillation identical in nature to that of a condenser circuit. We will only consider the fundamental oscillation although there may be harmonics of a greater frequency. It is found in the above open lineal oscillator that the current and voltage have a 90 degree displacement. The highest potentials gather at the extreme ends of the rods while the voltage amplitude at the center is nil. Due to the 90 degree displacement, the greatest current value is at the center, where the voltage is lowest, while practically no current exists at the high potential ends. If the effective capacity on each side of the gap is equally increased the potential and current nodes and anti-nodes are not displaced from the positions already mentioned. If we consider the end capacities as weights, the point of greatest amperage will be at the point where a pivot should be placed to have the weights or capacities balance. Now if the capacity on one side was increased and assuming this an increase in weight, it is easily seen that to maintain balance, the pivot should be moved from the center position toward the heavier weight. This same condition exists in the lineal oscillator. If one end capacity is increased, the greatest amperage point and point of no voltage will be distorted toward that capacity. If this capacity is extremely large compared with the opposite capacity, our amperage point will be immediately next to the large capacity. (Deviating from our subject, a good ground of an antenna system is such a capacity, thus we find the highest current value and lowest point of potential immediately next to the ground.)

The same effect, as described, exists in the closed circuit, but as each side of the condenser has an equal capacity to the other side, the point of greatest current and least potential will be the mid point of the primary of the oscillation transformer, that is, assuming the length of leads as negligible. Now this is the point we want to place our gap. Although this is the point of no potential, breaking the circuit and introducing a gap will cause a difference in potential, but the potential difference at this point will be less than at a gap anywhere else in the circuit. It is seen that a reduction of gap potential will decrease the tendency of the spark to lead. It is probably unnecessary for me to state that the high potential necessary for charging the condenser, is of course

unaffected. The experimenter can design a method of inserting the gap at the midpoint of his oscillation transformer primary to suit his individual needs. Do not destroy the good features of the four gaps in series, however. I would suggest putting the stationary electrodes opposite consecutive electrodes of the roter to facilitate short connecting leads.

I would be glad to hear from those of the readers who are further qualified than I, on the above subjects.

Edmond Bruce,
731 Rock Creek Road. Washington, D.C.

QSP THE OLD MAN.

Ridgewood, N. J.., July 27, 1919

Dear Editor:

In regard to the two copies of QST sent me, QRK. I have only one criticism. Several local "little boys" are showing signs of breaking out with that instrument of torture known as the spark coil. Now, a first class Wouff Hong, made by a manufacturing company of recognized merit or even a home-made one seems to be the only way of combating this evil. This, then, is my kick. The photo of the O. M.'s original, one-and-only, none-genuine-with-this-signature, Wouff Hong, published in the June QST was not clear enough. Therefore, a detailed sketch with all dimensions and method of operation would have been rather more appreciated.

By the way, pse ask the O. M. if the title of his new instrument is from the Sanskrit or Scandanavian language.

Will have to QRT nw as I sure need gobs and gobs of code practice after the enforced vacation, and intend to copy NAA's press.

73 OM, CUL SK
Harold Rouclere.

AMATEUR PRESS SERVICE.

I wonder how many radio enthusiasts realize the many possibilities of amateur wireless, especially in the country districts.

For instance, before the war W. S. Taylor of Minonk, Ill., and the writer at Eureka, Ill., exchanged news items by wireless for each edition of the local papers where this "press service" was printed under the pretentious heading "By Radio". This news was always sent at noon so it never interfered with anybody trying long distance work at night. The college and high school basket-ball scores and any special occurrences were sent to amateurs in Peoria and given to the dailies for publication the next morning.

We keep out a bulletin board where weather reports and sometimes QST press are posted daily. A clock in the store window shows the correct time "by wireless". Before the closing of amateur wireless the board of supervisors offered to pay us to keep the court-house clock set right. On the last presidential election we kept out a bulletin board almost all night.

Yours truly,
Henry Klaus.

HIGH NOTE VS. LOW.

Battle Creek, Aug. 12, 1919.

Mr. K. B. Warner, Editor.

Dear Sir: When looking over some of the back QST Magazines, I ran across an article in the August issue of 1916 by S. Kruse, in which he recommends the low tone spark and proves to his satisfaction that they are superior.

All thru the winter of 1916 I used a frequency from 960 to 1440, the latter being used exclusively along toward the last.

I received communications from about 50 stations outside the 200 mile zone stating that the station was easily read thru interference and QRN. Several stated that it was the most dependable station they copied all winter, coming in on warm rainy nights and at all times.

I was able to keep up communication with 4BY up to the last minute, a distance of 650 miles and he reported signals strong.

Of course the set was constructed to give its best work on high pitch, using 840 square inch condenser on ⅛ in. plates and a voltage not over 15000, usually 12000.

I also would like to tell you of one of my other discoveries, which may be nothing new to you, however.

I have had considerable trouble with kick backs in the past and during the war in my operating I found that by placing the transformer on the floor that I cut my kick-backs entirely out.

The solution is this: My transformer created an induction in the wattmeter by being close to it, about 3 ft. away; also there were high frequency currents acting between the primary and secondaries of the transformer. These caused the action in the watt meter that punctured the potential coil.

I notice that with the transformer nearer the ground that this stops entirely even in the transformer.

I hope this will be a help to some one else having such troubles.

Yours sincerely, E. E. House.

Mr. House opens up a subject we haven't had an opportunity to argue since the war started: whether a high or a low note carries better. Instead of specific examples to support either view, isn't the answer in the design of the sets,—the voltage and the capacity, the peripheral speed of the gap, and particularly in the resonance adjustments of the secondary side of the power transformer?—Editor.

ALL SET, AND WAITING ON DANIELS

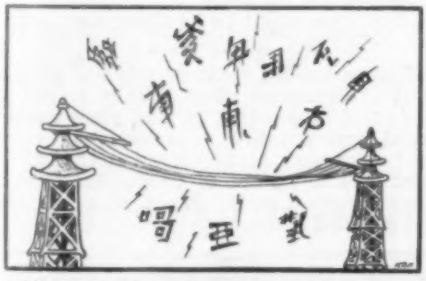
This efficient-looking A.R.R.L. station is located in Long Island City, N. Y., and operated by Mr. Charles B. Burch and Mr. Otto Skopee. The receiving set is practically all Grebe apparatus, and a Thordarson transformer may be seen on the transmitting side. The arrangement of the transmitter is novel and convenient. Note the lead-in of copper tubing, supported from the wall by electrose insulators; and the ground-lead of copper ribbon.

This is just one of thousands of A.R.R.L. stations which may be counted on for effective relay work but which are perforce idle until the ban is removed.

Let's have some more photographs, you fellows.

"STRAYS"

Funny how many folks ask us where old 8AEZ is, now that we're preparing to open up. We're afraid that 8AEZ by that name is a thing of the past, for its owner, Mr. M. B. West, has recently purchased a fine home in Waukegan, Ills., and is removing there from Lima for keeps. During the war Mr. West did a wonderful work in the Navy, in building up the Great Lakes Naval Radio School from a handful of men to a completely equipped school of 60,000 men, for which he received official commendation. Leaving the service as Lieutenant, j. g., he is now civilian assistant to the District Radio Material Officer at NAJ with the same duties he performed in uniform after the close of the school. It's a shame Waukegan isn't another mile from NAJ, but being only 4 miles away, Mr. West is going to be limited to a half kilowatt when he starts up again, as he promises to do. Some of us have long suspected, however, that the things he's able to do to a set won't cause this to be much of a handicap on him, and in fact he assures us we'll all have to sit up and take notice when he cuts loose. All right O. M.



(China to Have Wireless.—News Item.) China keeps a slant eye on America for new notions. Every time we take a hop ahead, the land of chop suey and flat-irons hop lee right after us. Alle samee lak Melicans. Altho the Chinks are old-timers at the mystery game, they haven't followed suit on our revolving doors. Wise old China! Anyhow, about the wireless. You'll probably think they've been a bit slow on adopting the air chatter business, but when you stop to figure that their alphabet measures 44,449 letters, you'll understand the tardiness. How to twist a ton of trick letters on the ticker, and buzz 'em backwards has been some puzzle. A Chinese wireless operator has to be an acrobat and juggler as well. The Chinese wireless companies will sure collect the yen per word in messages, since a short message sputtered in Chinese would cover a volume. Any outsider that picks off a Chinese wireless message will think his instrument has gone in for jazz.— From The Washington Herald.

The Annapolis station, NSS, with a 350 k. w. arc, now sends time signals at the same time as Arlington, using the high wave, approximately 17,000 meters. Not an amateur in the country with a CW set tuning that high should have any trouble in hearing NSS, and in fact for time signals this station is the best for inland amateurs in Montana, Wyoming, Colorado, etc. to listen for.

Ain't Nature wonderful? Just look at Seck Daniels!

To the many station owners who are these days getting right on their A.R.R.L. memberships, we'd like to make a suggestion: Get in touch with your District Superintendent direct, or your Division Manager if you have no Superintendent, and ask for a place in relay work. It is the officials of the Operating Department who make the appointments, and not this office. There are also good administrative positions open for the right men in the organization of lots of the Districts, and "the sooner the quicker", as the Irish say.

What next in concentrated inductances? If the present rate of progress is maintained, the girls will soon be wearing inductances for rings. Wonder if we can then get any closer coupling?

The present amateur situation is a big argument for the need of affiliation of Radio Clubs. Secretaries of Clubs, the A. R.R.L. will be glad to have your application. See August QST for details.

In this month's QST is advertised at last a cheap and efficient quenched gap. In tests this gap has run three hours on a half K.W. with a brick on the key, without changing note or unduly heating. Welcome, Q. G!

Now for a cheap but serviceable 500 cycle alternator of low power. A good field there for an enterprising manufacturer.

Mr. Arthur Batcheller, who so ably acted as Radio Inspector in the 1st District during the absence of Mr. Gawler, has left the service and is now Chief Instructor in electrical and radio theory at the Massa-

chusetts Radio and Telegraph School at 18 Boylston St., Boston. The school is under the general supervision of Mr. R. F. Trop, recently Asst. Dist. Communication Supt. of the First Naval District; and Mr. Guy R. Entwistle, formerly in charge of the Commercial Testing Dept. of American Radio & Research Corp'n at Medford Hillside, is Associate Instructor.

The school has a new ½ K. W. 500 Cycle transmitter, which is used for the demonstration of the principles of tuning and practical adjustment. In addition to the regular courses in radio and telegraphy, an advanced course is offered those desiring to qualify in higher branches of the radio profession. Instruction is given in the use of the radio compass, and of particular novelty is a Saturday morning class for wireless amateurs.

On a recent trip east, our Vice-President and the Assistant Central Division Manager discovered why certain radio messages used never to reach Chicago. They say every barn and farmhouse in Ohio has four lightning arresters on it and are firmly convinced that these devices absorbed most of the west-bound energy in days of yore. Guess we'll have to report it to the Leegonations.

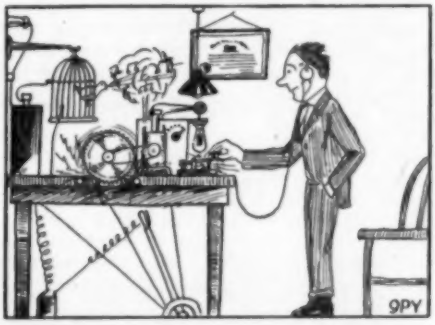
An interesting set designed to minimize the operations necessary in tuning is the Jeweler's Time Receiving Set of the Chicago Radio Laboratory, shown below. In the construction of the set the idea of the designer was to so simplify things that an operator with no previous knowledge whatever of tuning could not help but get the results he desired. The audion is built in with the tuner, and the set is regenerative.

With the detector in order, there are just two adjustments. All the jeweler has to do is to turn the knob marked "Tuning" until he gets the signals, and then amplify the signals by rotating the other knob marked "Regeneration". The set is ideal for the jeweler to whom receipt of time signals is a matter of business and who cannot spare the time to learn the operation of a more complicated set.

Description of Star Station XNUT.

"The receiving outfit consists of a 325-⅝-meter tight coupler, .2000 ohm phones; a phonograph sound box is used to detect the incoming signals, after which they are amplified by an Edison Mazda lamp.

The sending part comprises a bird-cage helix, inside which is a canary to give the spark a musical note. The rotary gap is



equipped with a bicycle sprocket wheel, and a most interesting innovation is its rotation by a young steam-engine. The transformer is a good 1 K. W., energized by a flashlight battery. A hand lever from a Ford makes a convenient antenna switch.

With this outfit I can send to the moon, and recently I heard a hurry-up call from a daffy-house on Mars."

(Boy, you ought to be there now.—Ed.)

Hear about the plant of this Philadelphia ham? Wonderful plant. Very strong indeed; self-supporting, no guy-wires needed; initial cost practically nothing; no equipment necessary to detect its radiation. A plant said to be out of proportion to most other plants there. What was it? Oh, just a Sun-Flower.

NEW TRANSMITTING APPARATUS

(Concluded from page 25)

from .0018 mfd. to .009 mfd. in steps of .0009 mfd.—a most convenient feature in adjusting the secondary power circuit to resonance with the supply circuit.

The oscillation transformer is designed particularly for 200-meter work, and looks like a real amateur built it. The turns are 1 inch heavy copper ribbon, supported in fibre strips, and it looks business-like and efficient. Using one complete outside turn on the primary and the maximum capacity of their condenser, .009 mfd (more than generally desirable), the wavelength is 200 meters, but sufficient inductance is provided in the 3¾ turns to cover amateur tunes with the condenser reduced as low as .004.

The rotary gap is the saw-tooth style—

"the gap that made Chicago famous"—a type which was in much favor with long-distance amateurs throughout the Mississippi Valley in the pre-war days. It is of ⅛ inch aluminum, and available with either 8 or 16 teeth.

The Thordarson line shows the influence of advanced amateur ideas in transmitters, and is a welcome adaptation to manufactured apparatus of those principles which practical long-distance amateur work has shown desirable.

LEARN WIRELESS TELEGRAPHY

Fascinating and Educational Work—Big Salaries—Prepare Now

The United States Shipping Board is making heavy demands upon us for **Dodge-trained** wireless operators. Travel all over the world, secure, free, unsurpassed living accommodations and earn a big salary.

We Also Teach Morse (Wire) Telegraphy and Railway Accounting

School established 45 years. Endorsed by wireless, railway and telegraph officials. Low rates. Students can earn living expenses while attending school. **Catalog Free. Write Today.**

Dodge's Telegraph and Wireless Institute 27th St. *Valparaiso, Indiana*

8,000 MILES

is the record (amateur) with our Audio-Tron Detector.

THE AUDIO-TRON

DETECTOR - AMPLIFIER - OSCILLATOR

Price postpaid $4.50

Can we send you one C. O. D. ?
No extra charge.

Jensen Electric Co.

RADIO APPARATUS

1949 Huron Street CHICAGO, ILL.

The Oldest Radio Supply House in New England

Agents for all reliable lines of apparatus

GEO. S. SAUNDERS CO.

168 Washington St. 11 Devonshire St.
BOSTON, MASS.

POSITIONS GUARANTEED

To Every Graduate of Our School
By Four Largest Radio Concerns

$125 PER MONTH PLUS ALL EXPENSES

Modern Equipment Special Short Course
Individual Instruction
Finest Staff of Teachers Available

DORMITORY — SWIMMING POOL

Call or Write for Illustrated Booklet

Y. M. C. A. RADIO SCHOOL

DEPT. R

153 EAST 86TH ST. NEW YORK, N. Y.

"BEST RADIO SCHOOL IN THE EAST"

Can you beat the Double A quality goods?

Short wave regenerative sets
150 to 600 meters at $25.00

Two step amplifiers guaranteed to increase signals 60 times; price $20 without bulbs

Audion control panels complete with cabinet $9.50

All our instruments guaranteed

RADIO EQUIPMENT CO.
1525 N. FAWN ST., PHILADELPHIA, PA.

GENUINE
AUDIOTRONS
DETECTOR - AMPLIFIER - OSCILLATOR
Double Filament
$5.00
Prepaid
Complete supply of Panels, Parts, etc.

R. W. PRATT
Agent for AudioTron Sales Co.
Longfellow St. WESTBROOK, ME.

BOYS How would you like to have this ghastly warning hanging in your room? It will make your station or den look big and command respect. It is the neatest sign made. Printed in bright red with big bold letters on stiff cardboard. 7¼"x 11¼". Price 20c, 3 for 50c, postpaid anywhere. Don't miss this opportunity.

LEONARD BECK
Dept. C., 102 Meridith Ave., Arverne, N. Y.

EUGENE C. BROWN
PATENT LAWYER
Electrical Engineer, Lehigh Univ.
Former Examiner Elec. Div. U. S. Patent Office
PATENTS AND PATENT LITIGATION
734 Eighth St., N. W. WASHINGTON, D. C.

WILCOX PANEL SWITCH
"The Best"
1½" Radius Postpaid
Pol. brass fin. switch 50c
Nickle pl. fin. switch 60c
Turned and pol. knob 25c
Brass switch points 2c
Nickle pl. switch pts. 4c
THE WILCOX LABORATORIES Lansing, Mich.

CLASSIFIED ADVERTISEMENTS

Five cents per word per insertion, in advance. Copy must be received by the 10th of month for succeeding month's issue.

TELEGRAPHY (both Morse and Wireless) AND RAILWAY ACCOUNTING taught thoroughly and quickly. Big salaries now paid. Great opportunities. Oldest and Largest School—est. 45 years. Catalog free. Dodges Institute, 28th St., Valparaiso, Ind.

FOR SALE—No. 2 jr. Omnigraph; 250 watt Amco transformer; Crystaloi detector $1.25; and 1 kw. oscillation transformer. Harold Newman, Danville, Illinois.

WANTED—Paragon RA6 Regenerative Set. FOR SALE—Oscillation transformer, phones, new Audiotron. Robert C. Bishop, Locust St., Lockport, N. Y.

WIRELESS BUGS, quick postpaid prices. Standard 1¼" switch knob-lever complete 35c. Brass switch points with screws, dozen, 25c. State panel thickness. Advise your rush wants in parts. Novotoy Electric Shop, 2200 Fifth Ave., Charlotte, N. C.

FOR SALE—1 K. W. Packard and ½ K. W open core transformers, Wireless Specialty leyden jars, oil condenser, oscillation transformer, hot wire ammeter, "kick-back preventer," speed and straight keys, electrose insulators, 6-60 Witherbee storage battery, unmounted Murdock and United Wireless Co. variable condensers, hard rubber panel, audion bulb and misc. apparatus, W. J. Eckstein, 255 Stuyvesant Ave., Lyndhurst, N. J. Phone, Rutherford 589J.

FOR SALE—One Mignon receiving cabinet, R. L. C. 5, $25.00; also condensers, aerial wire, other apparatus and books; all are in good condition. Write for prices. Roy Ward, Bardstown Junction, Ky.

FOR SALE—Sending and receiving apparata complete; all instruments first class and best available. If interested write for detailed description; will sell at ½ cost. E. Masztics, 12118 Madison Ave., Lakewood, Ohio.

FOR—SALE—Receiving apparatus. Stamp for particulars. John Sellors, 1228 Mt. Royal Ave., Baltimore, Md.

WIRELESS AMATEURS

Here is what you have been looking for: "THE JIFFY CONNECTOR." It will connect a Plate battery for the Audion (No. 703), in less than a minute; NO SOLDERING to do; just snap these "JIFFY CONNECTORS" on the terminals. A box to hold 10 No. 703 Batteries, Separators, and 1 set of "JIFFY CONNECTORS," price $1.00 by mail. I also have Bakelite Rubber Panels, Grey Seamless Cardboard Tubes, etc.

A. T. HOVEY
No. 62-A ST. GERMAIN ST., BOSTON MASS.

DISTINCTIVE APPARATUS
Enclose stamp for catalog
AMERICAN ELECTROMOTIVE CO.
20 EAST 42ND ST. NEW YORK, N. Y.

"B" (storage) BATTERIES
(INEXPENSIVE—DURABLE—EFFICIENT)
These batteries are a modification of the well-known "Marcuson" Potential Batteries, which have been the standard for over ten years.

E. MARCUSON
70 CORTLANDT ST. NEW YORK, N. Y.

G. A. STANDARDIZED SUPPLIES

The General Apparatus Company has established a series of Standardized Supplies and Materials, covering such necessities as brass rods and tubes, wood and machine screws, Standardized bakelite panels, magnet wire, high frequency cable, G-A-lite inductance tubing, and other supplies for radio, model, and electrical workers.

G. A. STANDARDIZED B BATTERIES, 22.5 VOLTS

Built according to the specifications of the U. S. Signal Corps and Bureau of Steam Engineering. 90% of the B batteries used by the Signal Corps were of this identical design, the formulae for which are known to only one chemist. That these batteries are, in every respect, the best made is testified by the fact that they were used almost exclusively by the U. S. Government.

SIGNAL CORPS TYPE, 3¼" long, 2" wide, 2¼" high, operates one Audion 250 hours continually, average life 3 months. Price $1.50, postage, 10c.

NAVY TPE, 6⅝" long, 4" wide, 3" high, operates one Audion 1,000 hours continually, average life 10 months. Price $2.50, postage, 15c.

THE BEST B BATTERIES MADE AND LOWER IN PRICE THAN ANY OTHER MAKE

G. A. CONSTRUCTION PHAMPLETS ON STANDARDIZED APPARATUS

M. B. Sleeper is preparing for the G. A. Company a series of pamphlets on the construction of transmitting and receiving apparatus, just the kind of informaton Experimenters need on simple apparatus of new and highly efficient design. All detailed drawings are given.

1. INDUCTANCE TABLES: Simple, direct reading, for coils 3 to 10" in diameter by ¼" steps, 0.1 to 10" long in 0.1" steps. For single layer and banked coils, figure 8 coils, and flat pancakes.
2. DIRECTION FINDER: Detailed drawings of a simple unilateral Direction Finder of G. A. Standard Panel design, 200 to 2,500 meters. Can also be used as a straight receiver.
3. AUDION TRANSMITTER: A high efficiency telephone or telegraph set that can be built with simple materials. Range over 10 miles with single Audion receiver. Inexpensive to construct.
4. SUPER RANGE RECEIVER: With one Audion will give wonderful results on long wave stations. Copies Nauen with one wire antenna.

PRICE, 25c EA.; SPECIAL OFFER, 3 for 60c., 4 for 75c.—YOU NEED THEM ALL, SEND AT ONCE

WRITE FOR THE G. A. INTRODUCTORY BULLETIN

G.A.

158 E. 18th St. **The General Apparatus Company** New York City

Radio Laboratory Apparatus

We specialize in good but inexpensive apparatus for experimental radio work. Measure capacity, inductance, wave length, and take V. T. curves with our instruments.

Send for our Scientific Experiment Books, Complete Radio Series of 5 books, $1 postpaid.

Send 6c. for our Catalog No. 1

The C. D. TUSKA CO.

HARTFORD, CONNECTICUT

DUCK'S BIG 300 PP.
Wireless and Electrical Catalog

Is now as it always has been, the largest and most complete and dependable Wireless Catalog published. Mailed for 12c. in stamps or coin which may be deducted on first order of one dollar. Catalog not sent otherwise. This catalog costs us twice the price of other catalogs.

Everything in wireless **worth while** is listed in this catalog. The experienced amateur will tell you to see our catalogue before buying. You are thereby insured against an unwise purchase. It is the Beacon Light to guide you right in the selection of your wireless apparatus. No bigger or better values are obtainable elsewhere. Send for revised price list. It is yours for the asking.

THE WILLIAM B. DUCK CO. 243-245 Superior St., Toledo, Ohio

Baldwin Mica Diaphragm Telephones

In order to enable every Wireless Operator to use the well known Baldwin Phones, we have reduced the prices as follows:

Navy Type "C"	**$15.50 Each, F. O. B. New York**
Smaller Type, "D"	**16.50 Each, F. O. B. New York**
Newest Type Made, "E"	**17.50 Each, F. O. B. New York**

More rugged and just as sensitive

If unable to procure these instruments from your local dealers send your order direct to this office, with money order including postage (25c.) to cover charges.

IF ANY OPERATOR DESIRES A CHEAPER COST PHONE THAN THE BALDWIN, we can recommend the BROWNLIE adjustable phone, which is very sensitive.

Price, $11.00, F. O. B. New York.

John Firth & Company, Inc.
81 New Street, New York City

The BARR
MERCURY-CUP WIRELESS DETECTOR

The most efficient Detector on the market. Tested by the United States Government and Marconi Wireless Telegraph Company.

Increases the efficiency of every wireless receiving set by making the signals clear, sharp and distinct.

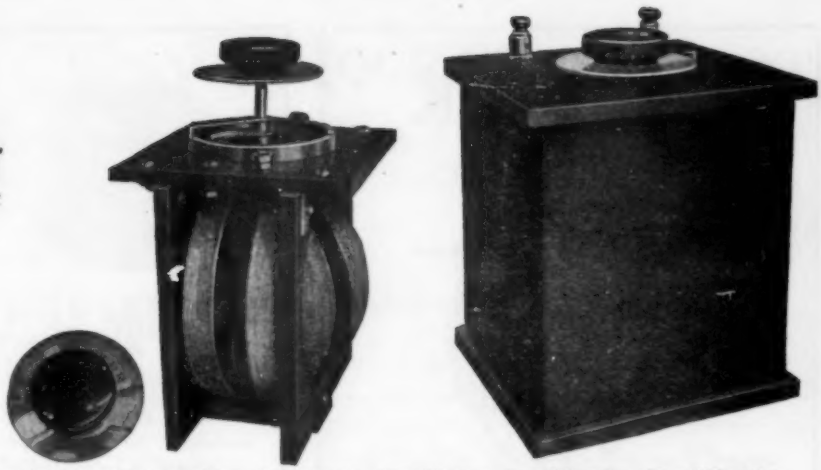
Instantly adjustable at a constant pressure.

FOR FULL INFORMATION AND PRICE — WRITE

The Barr Mercury-Cup Detector

Dept. E, THE WYOMING, WASHINGTON, D. C.

A New Variometer for the Amateur



Type S.S. Variometer, in three sizes: maximum inductances, 1 millihenry, 5 millihenries, 20 millihenries. Mounted $20.00; unmounted $16.00.

Variometers provide an inductance as easily and gradually variable as a rotary condenser. They are the ideal inductance; efficient, no poor contacts, dead-end losses or capacity losses from multiple taps.

Clapp-Eastham Variometers are designed to give the amateur a Precision Instrument at a low price. Compact in size and beautiful in workmanship. Especially designed to minimize distributed capacity. Readily adaptable to panel mounting. Equipped with a special drum switch automatically actuated by the control knob, whereby the coils are in parallel the first half revolution providing an inductance continuously variable thru 360 degrees, giving double the range of adjustment available wth other variometers.

Fully described, with other New Developments, in our interesting Bulletin Y.

NEW BULLETIN R OF RECTIFIERS FOR STORAGE BATTERY CHARGING NOW READY.

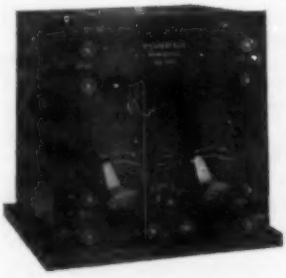
CLAPP-EASTHAM COMPANY

141 MAIN STREET CAMBRIDGE, MASS.

REMLER RADIO MFG. CO., 62 Post St., San Francisco, Cal., Pacific Coast Representatives

---

Are You Getting the Most Out of Your Receiver?



THE ether is full of signals these days, some easy to hear and some inaudible—inaudible because the proper apparatus is not being used. It is to make those inaudible signals audible that the Grebe RORB two-stage audio-frequency amplifier has been designed. Here is a properly balanced two-stage amplifier, which gets the most out of available vacuum tubes without distortion. A telephone cam switch with auxiliary contactors accomplishes the change from the "off" position to either one or two stages without necessitating any other manipulations. The filaments, as well as the stage circuits, are controlled by this cam switch. This is a feature not found in other amplifiers available at present. Send for bulletin R-108.

TYPE RORB 2-STAGE AMPLIFIER, PRICE $45.00

A. H. GREBE & CO. Richmond Hill, N. Y.

MURDOCK

NO. 55

2000 OHM DOUBLE SET

$4.50

3000 OHM DOUBLE SET

$5.50

Made for long and
Useful service in
Radio stations where their
Dependable and sensitive
Operation makes them the
Choice of those who
Know GOOD 'phones.

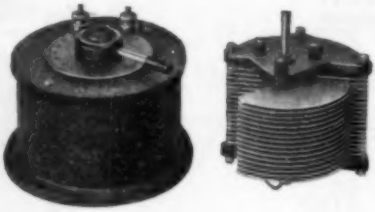
ORDER YOUR SET NOW—
Try it out thoroughly.
IF IT DOESN'T SUIT, SEND IT BACK AND GET YOUR MONEY

Bulletin 19 shows a splendid line of the type of apparatus you want. Send for a copy.

WM. J. MURDOCK CO.

65 Carter St.
CHELSEA MASS.

221 SECOND ST., SAN FRANCISCO, CALIF



Variable Air Condenser

TYPE 182

A high grade condenser with plates designed to give approximately even variation of wavelength throughout the scale.

Made in two sizes: .0007 M. F. at $10.00 and .001 M.F. at $13.00.

Full data on request.

General Radio Co.

WINDSOR STREET
CAMBRIDGE MASS.

WIRELESS

PARTS, SUPPLIES,

Bakelite-Dilecto Panels

KNOB AND SWITCH LEVER with knob 1¼ x ¾, spring brass lever securely fastened to knob, large brass bearing and shaft threaded 6-32. Each 40 cents. Postage 4 cents.

CONTACT POINTS, brass, 7/32 x 7/32, with screw for mounting. Per dozen, postpaid, 25 cents.

KNOB, as used on switch described above, 1¼ x ¾, with hole in center for mounting. Each, postpaid, 20c.

AUDIOTRON TUBES
postpaid and insured, $5.00

Send 6 cents in stamps for our catalog and get on our mailing list for future bulletins.

Bakelite Dilecto Panels in sizes as noted. Best grade.	9½ x 19 x ¼	Black XX	$4.00
	19 x 19 x ¼	Black XX	8.00
	9½ x 19 x 3/16	Black XX	3.00
	19 x 19 x 3/16	Black XX	6.00

Include postage on 3 lbs.

A. H. CORWIN & CO.

924 Kinney Building Newark, N. J.

WELL, BOYS!

From ten years old to three-score years and ten, we can all "sit in" and listen again; if we have the instruments to listen on. We are with you still, to supply you with all kinds of parts: Contact Points, Switch Handles, best grade Tubes, Woodwork, etc.

A Large New Catalogue will be off the press soon. Watch this space to learn WHEN, then send for one

F. B. CHAMBERS & CO.
2046 ARCH ST., PHILA., PA.

OUR NEW CATALOG

OF

COMPLETE RECEIVING APPARATUS

IS NOW READY

Send Today for Your Copy

AUDIOTRON SALES CO.
Lick Building
SAN FRANCISCO, CAL.

AMATEURS!

Send for our latest bulletin of wireless apparatus. We can furnish any wireless instrument made at the lowest prices.

Eastern Distributors for the AudioTron double-filament tube detector.

Write us immediately

RADIO ELECTRIC CO.
4614 HENRY ST. PITTSBURG, PA.

Get Our Prices

on the Wireless Apparatus you need, before buying.

We handle new and second hand instruments on which we can save you money. All Second Hand instruments guaranteed to be in perfect working order.

WHAT DO U NEED ?

Send us your list now

Radio Equipment Co.
630A Washington Street, Boston, Mass.

POTENTIOMETERS

I have on hand a limited supply of Audiotron B-Battery potentiometers which I am offering at a great reduction. Unit is mounted in Bakelite and Knob and Lever are all of the best material.

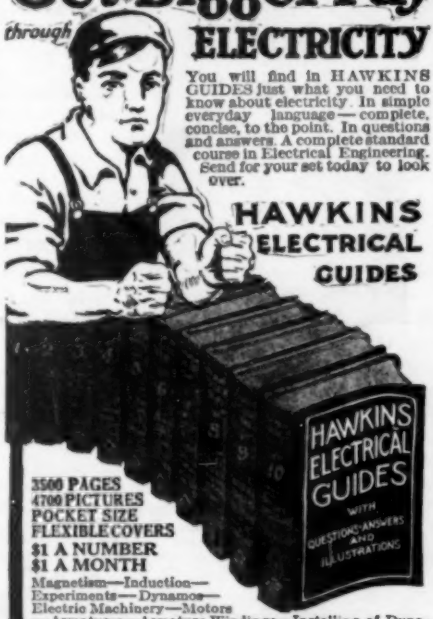
PRICE, $0.90

Sent postpaid when cash accompanies order.

F. C. MYERS
Agent For Audiotron Sales Co.
45 Albany Trust Co. Bldg., Albany N. Y.

Get Bigger Pay

through **ELECTRICITY**



You will find in HAWKINS GUIDES just what you need to know about electricity. In simple everyday language — complete, concise, to the point. In questions and answers. A complete standard course in Electrical Engineering. Send for your set today to look over.

HAWKINS ELECTRICAL GUIDES

2500 PAGES
4700 PICTURES
POCKET SIZE
FLEXIBLE COVERS
$1 A NUMBER
$1 A MONTH

Magnetism—Induction—Experiments—Dynamos—Electric Machinery—Motors—Armatures—Armature Windings—Installing of Dynamos—Electrical Instrument Testing—Practical Management of Dynamos and Motors—Distribution Systems—Wiring—Wiring Diagrams—Sign Flashers—Storage Batteries—Principles of Alternating Currents and Alternators—Alternating Current Motors — Transformers — Converters—Rectifiers—Alternating Current Systems—Circuit Breakers—Measuring Instruments—Switch Boards—Power Stations—Installing—Telephone—Telegraph—Wireless—Bells—Lighting—Railways. Also many modern Practical Applications of Electricity and Ready Reference Index of the 10 numbers.

Shipped to you FREE. Not a cent to pay until you see the books. No obligation to buy unless you are satisfied. Send coupon now—today—and get this great help library and see if it is not worth $100 to you—you pay $1.00 a month for 10 months or return it.

SEND NO MONEY

THEO. AUDEL & CO., 72 Fifth Ave., N. Y. Please submit for examination Hawkins Electrical Guides (Price $1 each). Ship at once, prepaid, the 10 numbers. If satisfactory I agree to send you $1 within seven days and to further mail you $1 each month until paid.

Signature_____

Occupation_____

Employed by_____

Residence_____

Reference_____ QST

THE HEART OF THE WIRELESS

An Amateur Station Without a Vacuum Tube Is Years Behind the Times

MARCONI V.T.

$7.00 each

Under agreements recently effected the Marconi V. T. is the only vacuum tube, or audion, which may be sold to amateurs, laboratories, schools of instruction and experimenters.

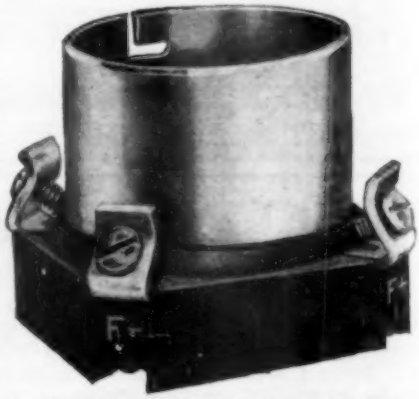
THE APPROXIMATE OPERATING LIFE OF THE MARCONI V. T. IS 1,500 HOURS.

Fleming Pat. No. 803684
DeForest Pat. Nos. 841387-879532

Class I.—Designed for use as a detector; operates with plate potential of 20 to 60 volts.

Class II.—Designed for use as an amplifier; plate potentials from 60 to 110 volts may be applied.

Tubes in either class may be used for detection or amplification, but those of Class I are best as detectors, and Class II tubes are superior as amplifiers.



STANDARDIZED SOCKET $1.50 additional

The Marconi Resistance, connected in the circuit between the grid and the filament of the Marconi V. T., is made in the following standard sizes:

½ megohm, 1 megohm, 4 megohms, 6 megohms.

Resistances of any special fractional values up to 6 megohms can be supplied.

STANDARD RESISTANCE, COMPLETE $1.00

Send all remittances with order to COMMERCIAL DEPARTMENT

Marconi Wireless Telegraph Company of America

Sole Distributors for De Forest Radio Telephone & Telegraph Co.

227 BROADWAY, NEW YORK

RETAIL SALES AND EXHIBITION ROOMS, 25 ELM ST., NEW YORK

BRANCH OFFICES:

Schofield Bldg., Cleveland, Ohio
American Bldg., Baltimore, Md.
Insurance Exch. Bldg., San Francisco, Cal.
136 Federal St., Boston, Mass.
301 Commercial Bank Annex, New Orleans, La.
109 South 2nd St., Philadelphia, Pa.

AMAZING AUDION DETECTOR VALUES-$9.50 $11.75 $18.85 $22.00

Remarkably efficient and handsome audion control panels within the PRICE LIMIT of EVERY AMATEUR, BUILT AND DESIGNED FOR THE AUDION, AS ONLY THE MAKERS OF THE AUDION CAN BUILD IT. In the past, instruments of this calibre have never been offered at twice these prices.

Type P-500, $22.00

Type P-401, $11.75

GENERAL SPECIFICATIONS ALL MODELS: Beautifully engraved and grained genuine bakelite panels; 4 prong heavy nickled tube receptacles; smooth running, positive acting, adjustable rheostats; impregnated efficient mica stopping condensers; adjustable or fixed grid leaks with polished nickel covers; bakelite covered binding posts with new slotted positive connecting feature; positive segmentally connected nickel plated switches; 40 volt B battery of two 20 volt type units cast enblock with operating life of 6 to 12 months—a remarkable advance in B batteries; handsome quartered oak cabinets, round corners, standard de Forest "Early English" finish; perfect workmanship and expensive design throughout.

Type P-400 Audion Panel—Consists of tube receptacle, grid leak and condenser, rheostat and binding posts for connection to tuner, A and B batteries on bakelite panel 7½" x 7½" without cabinet and B batteries $9.50

Type P-401 Audion Panel—Same as above with cabinet $11.75

Type P-402 Audion Panel—Larger panel with 40 volt B battery in cabinet $18.85

Type P-500 Audion-Ultraudion Panel—Type P-402 Panel with two switches for audion-ultraudion connection and either 20 or 40 volt B battery in Cabinet $22.00

Note: All de Forest audion apparatus is sold without the tubes. Audion detector oscillator or amplifier tubes, $7.00 each additional.

Catalog sent on receipt of 10c. in stamps to cover postage.

De Forest Radio Tel. & Tel. Co.

1415 Sedgwick Ave. NEW YORK CITY

EVERYTHING FOR AN IDEAL AERIAL

COMPLETE OR PARTS — "CQ — CQ — CQ" — FOR LAND OR MARINE STATIONS

OUR SPECIALITY

SPARS
BRIDLES
INSULATORS
WIRE — ROPE

TO AMATEURS | 2, 3, 4 & 6 WIRE ANTENNAS for 200 meters; LONG WAVE 2 WIRE RECEIVING ANTENNAS.

Construction: Specially designed, turned and perfectly tapered SPARS—fitted with galv. steel mast bands; best grade flexible galv. wire BRIDLES; galv. pulleys; ELECTROSE INSULATORS; seven strands PHOSPHOR BRONZE ANTENNA WIRE; high-grade WEATHER-PROOF HOISTING ROPE.

Distributors of HIGH GRADE RECEIVING APPARATUS

"Made in America"

Prices quoted on application. Specify your particular requirements.

"K-K" "AT YOUR SERVICE" "K-K"

NORTH AMERICAN AERIAL SPAR MFG. CO. Dubuque, Iowa

Federal Audio-Frequency Transformer

The No. 226-W
Price $7.10

The only Audio-Frequency Transformer designed for use with the Marconi V. T. Class I and II and approved by expert engineers.

WONDERFUL RESULTS ARE OBTAINED IN AMPLIFICATION BY IT

All who have a Marconi tube, or one of same internal impedence, should have a FEDERAL No. 226-W, Type A, in order to get high class results.

WRITE FOR BULLETIN 102-W

We also furnish the Marconi Tubes, Standard Mountings and Leak Resistances, at regular prices.

Federal Telephone and Telegraph Co. BUFFALO, N. Y.

MANUFACTURERS OF

STANDARD AIR CORE AUDIO-FREQUENCY TRANSFORMERS. "LIBERTY" HEAD TELEPHONES. FAMOUS "CENTURY" HIGH-FREQUENCY BUZZERS. THE ORIGINAL ANTI-CAPACITY SWITCH. STANDARD PLUGS, JACKS AND ACCESSORIES.

UNIVERSAL RADIO APPARATUS

THIS line of new apparatus comprises several interesting instruments. There is a regenerative receiver which covers practically the entire spark range. It has a wave length range of from about 170 to 2550 meters. The continuous wave receiver has a range up to 17,000 meters and is contained in its entirety in a cabinet measuring about 8″x12″x6″. This does away with cumbersome loading coils and loose couplers which used to occupy so much space on the operating table.

We control the patent rights and are sole manufacturers of the MIGNON SYSTEM apparatus.

Send stamp for catalogue

Universal Radio Manufacturing Corporation

Dept. M Elmira, N. Y.

Have You Ever Heard Lyons or Nauen?

We can supply you with the complete apparatus necessary for the successful reception of undamped wave stations and can make immediate deliveries.

An efficient Arc Receiver can be had at a surprisingly low cost and good results are certain with the apparatus we furnish.

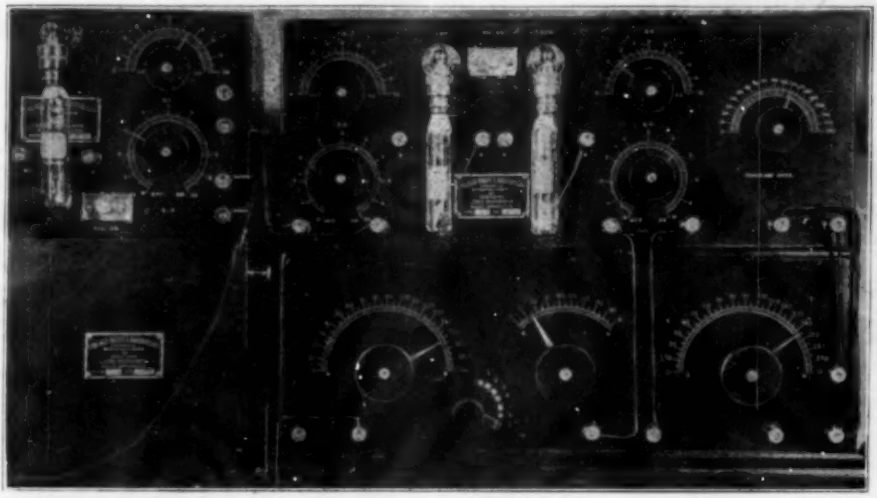
Upon request we will furnish the proper hook-ups and give full instructions for the installation and operation of any of our apparatus.

We carry a full and comprehensive line of radio material and apparatus and make a specialty of filling all orders the day received.

Our Catalog will soon be ready for distribution and the many requests for it will then receive attention.

MANHATTAN ELECTRICAL SUPPLY CO. 1106 Pine St., St. Louis, Mo.

The most sensitive receiving set made—a Paragon RA-6, an Amplifigon, type AGN-1, a second step amplifier, type AMP-1, and a special battery box.



Sold Complete or in Part, Equipped for ANY Type Audion Tube.
A Limited Number of the Genuine, Famous PARAGON RA-6 Regenerative Receivers Now Ready for Distribution by Us.

Send for Our Bulletin J-19 of High Grade Radio Apparatus.

Licensed under DeForest patents Nos. 841,387 and 879,532

CHICAGO RADIO LABORATORY 1316 Carmen Ave., Chicago, Ill.

IMMEDIATE SHIPMENTS

SWITCH POINTS

	Doz.	50	100
No. 626—¼" dia. x 3/8" high, tapped 6-32	$0.30	$1.00	$1.75
No. 627—¼" dia. x ⅜" high, ⅛" shank 6-32	.36	1.25	2.00
No. 628—¼" dia. x ⅜" high, tapped 6-32	.30	.90	1.50

Above prices plain brass finish. Nickel points 50% advance.

602

KNOBS

No. 602—1" dia., 8-32 bushing	$0.10	$1.00
No. 606—1¼" dia., 13-16" high	.20	2.00

Postage on above extra

606

SEND TODAY FOR CIRCULAR G SHOWING COMPLETE LINE

SHOTTON RADIO MFG. CO., P. O. Box 3, SCRANTON, PA.

EVERYDAY ENGINEERING

Each month contains the equivalent of a 60 page book on radio as well as a fund of articles on experimental work. And the price is only ~ Fifteen cents.

EVERYDAY ENGINEERING MAGAZINE
605 PUTNAM BLDG, 45th ST, NEW YORK

PERFECTION VARIABLE CONDENSERS

KNOCKED DOWN—YOU ASSEMBLE AND SAVE MONEY.

Full instructions in each box. Ready to mount on panels.

11 Plate	$1.75
21 Plate	2.25
43 Plate	2.50

No outside cover, but has scale, pointer and knob.
Small hole to cut.
Guaranteed easy to mount.

TRESCO BOX 374 DAVENPORT, IOWA.

Quality Apparatus

RADIO APPARATUS

SEND TODAY!

Sears, Roebuck and Co.

Get This 40-Page Catalog of Radio Apparatus Mailed Postpaid

This forty-page book of Radio Apparatus shows nearly all the latest appliances both for receiving and sending wireless messages. It is written in non-technical terms so that it can be understood just as easily by the inexperienced person as by the wireless expert.

Prices are low when you consider the quality of the apparatus. Here is a sample of our prices:

6A9314—½ K. W. Meteor Wireless Transformer, 10,000 volt secondary $13.95

There are many bargains just like this. Send for this book, 6244Q, today.

Sears, Roebuck and Co., Chicago

"ASK ANYONE WHO HAS USED IT"

BRANDES WIRELESS HEADSET

'Superior' 2000 ohms $7

SAID DENVER, COL., TO VALLEY STREAM, L. I.:

One of our most enthusiastic customers communicates by wireless from his home in Denver to a friend on Long Island. He uses a Brandes Headset—after exhaustive tests and comparisons. (Name on request).

Think of the help to wireless operators that the perfect sensitiveness and dependability of Brandes Headsets provided during the war. Life and death depended upon **hearing correctly.** They are made today just the same and give the same quality of service.

TRIAL OFFER Test out Brandes Wireless Receivers against any other make. Test them for sensitiveness, clearness and distance. If within ten days you're not only satisfied but enthusiastic over them—back comes your money without a question.

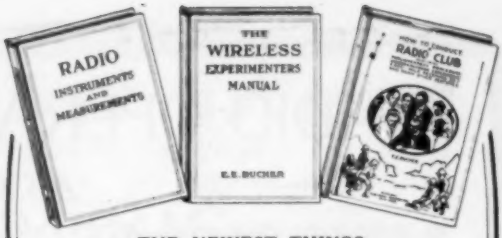
Prove for yourself the fine quality, the "matched tone." The two diaphrams, toned exactly alike, strengthen the signals and prevent blurring. Used by many U. S. Gov't experts, and experts abroad; by colleges and technical schools; and by professionals and amateurs everywhere.

SEND 4c. FOR CATALOGUE F

C. BRANDES, Inc.

Room 821, 32 Union Square, New York

WIRELESS RECEIVER SPECIALISTS



THE NEWEST THINGS

IN WIRELESS

ARE IN THESE THREE BOOKS

Just Off the Press

RADIO INSTRUMENTS AND MEASUREMENTS

Every amateur should have this book as it answers the questions you want to ask and covers all phases of the subject matter indicated by its title. Cloth Bound, 320 Pages, $1.25.

THE WIRELESS EXPERIMENTERS' MANUAL

By E. E. Bucher. Mr. Bucher's latest book. The only one that comprehensively covers all phases of wireless work, including the latest practices in both Radio Telegraphy and Telephony. Most complete text book on these subjects yet published. Cloth Bound. Approximately 300 Pages. Price $1.75.

HOW TO CONDUCT A RADIO CLUB

By E. E. Bucher. One of the most popular wireless books ever published. Covers parliamentary procedure, indoor and outdoor experiments, 5,000-mile receiving sets, use of vacuum tubes and many other subjects. Paper Cov. 148pp., 50c.

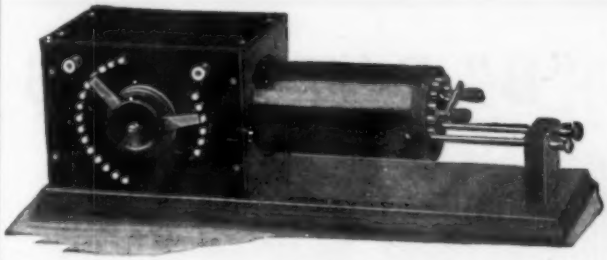
THE WIRELESS AGE

A monthly magazine that will keep you posted on the up-to-the-minute things in wireless communication. Official organ of the National Amateur Wireless Ass'n. Price Per Year $2.00.

SPECIAL COMBINATION PRICE, ALL FOUR ONLY $4.50

WIRELESS PRESS

1852 Woolworth Building, New York



J. F. ARNOLD

(Established 1910)

2082 LEXINGTON AVENUE **NEW YORK**

ARNOLD NAVY MODEL LOOSE COUPLER

Altho this instrument has been before the public for five years, the demand for it is just as persistent; and altho many pre-war standards have been swept away you will find, after much experimentation with new-fangled ideas, that for selectivity and sharpness of tuning you "have to go some" to beat a well-designed Loose Coupler.

The instrument illustrated above is correctly designed, its workmanship the best, and it presents much better value than you expect—if you could see one and operate it, you would expect it to cost more.

For special design binding posts, knobs, switches, rheostats, and in fact **better grade accessories,** send two-cent stamp for my bulletin.

RADIO APPARATUS

Distributors of all prominent makes:
DeForest, Wireless Specialty, Murdock, Grebe, General Radio, Clapp-Eastham, Brandes, etc., etc.

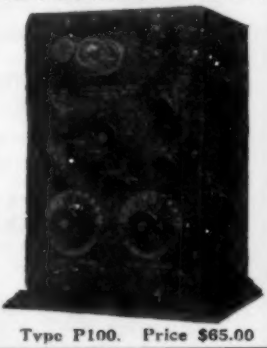
LARGEST AND BEST STOCK OF ANY HOUSE IN NEW ENGLAND

For real prompt delivery send us your orders for Honeycomb Coils, Unit Panels, Vacuum Tubes, Baldwin Telephones, Murdock 55's, Grebe Developments, etc.

F. D. PITTS COMPANY

Dept. A, 12 Park Square **BOSTON, MASS.**

DeForest Audion Control Box



Type P100. Price $65.00

RADIO OPERATORS NEEDED

ATTEND

MASSACHUSETTS
RADIO AND TELEGRAPH SCHOOL

18 Boylston Street
BOSTON

FOR INSTRUCTION IN RADIO AND TELEGRAPHY

Prescribed course prepares Radio Operators to obtain Government license. One month's service with Merchant Marine at salary of $100 to $125 more than repays cost of tuition.

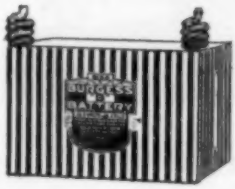
Complete course in Commercial, Railroad and Brokerage Telegraphy.

Day class, 9 A. M. to 1 P. M.
Evening class, Monday, Wednesday and Friday, 7 to 9 P. M.
Radio amateur class Saturday, 10 A. M.
Students may enter any Monday.

½ K. W. 500 CYCLE SET RECENTLY INSTALLED

BURGESS "B" BATTERIES

22.5 VOLTS
15 CELLS



THREE SIZES

No. 2156—3" x4" x6⅝"
No. 5156—2 1/16" x2 9/16" x4 1/16"
No. 4156—2⅛" x2" x3⅜"

BURGESS "B" BATTERY construction is being specified by the Government for its vacuum tube batteries. They have long life, high capacity and noiselessness.

Write for prices and information to

BURGESS BATTERY COMPANY

Laboratories
Madison, Wisconsin

Sales Office
Harris Trust Bldg., Chicago

WIRELESS TAUGHT BY MAIL

By the Largest Radio School in the World

Staff of high class government instructors; 16 weeks' course. Now placing our graduates in fine positions. Pay runs from $110 per month and living expenses, up to $3500 per year.

REDUCTION IN TUITION TO GRADUATES

and, under certain conditions, you may obtain the course for practically nothing. We need thousands of operators, inspectors and radio aids. Fascinating work; interesting study; takes only a little bit of your time daily. Write today for illustrated catalogue and details of our profit sharing plan with students.

SERVICE RADIO SCHOOL

Dept. T, 900-2 Pa. Avenue **Washington, D. C.**

Manufacturers of Reliable Instruments
and
Distributors of All Prominent Makes of

RADIO APPARATUS

Everything Essential to the Successful
Installation of A RADIO STATION

Bunnell Apparatus is Sold by Dealers Everywhere

Catalog 40-Q on Request

Special Feature—
The Straight Line Radio Key

J. H. Bunnell & Co. *32 Park Place, New York*

TEL.
BACK BAY
5964

899 BOYLSTON ST.
BOSTON, MASS.

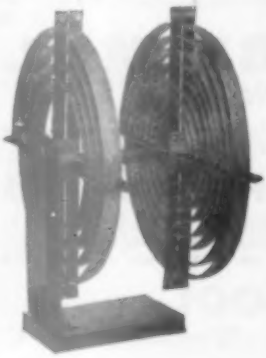
RADIO

Learn Wireless under former U. S. Government and Marconi experts. Tremendous demand for Wireless operators! Splendid opportunities now in the Merchant Marine. Big Salaries! Junior operators $100 per month, Chief operators $125, food and quarters besides. Equivalent ashore from $40 to $50 per week. Our graduates now in all parts of the world as Radio Inspectors, Instructors, Engineers, Operators, etc., etc. Interesting and fascinating work! During the War period alone the Eastern Radio Institute gave instruction to thousands of students, more than all other schools in New England combined. We positively have good positions actually waiting for every graduate and moreover we will now place in a good position without charge any man holding a Commercial operator's license regardless of where he secured instruction. This speaks for itself.

Remember the Eastern Radio Institute is the oldest, largest and best equipped telegraph school in New England and has thousands of satisfied graduates to its credit.

Thorough and practical courses in Wireless, Commercial, Railroad and Brokerage telegraphy. DAY AND EVENING CLASSES. START ANY MONDAY.

PRINT IN BINDING



1500 MILES ON 200 METERS

THORDARSON ELECTRIC MFG. CO.

501-515 JEFFERSON ST., CHICAGO

August QST published details of our 1500 Mile Transmitting Contest. While we are waiting for the ban to be removed, let us introduce our

TYPE T-OT OSCILLATION TRANSFORMER

Primary of this Oscillation Transformer consists of 3¾ turns of 1 inch heavy copper ribbon supported in fibre strips. The secondary consists of 7¾ turns mounted same as primary. Primary inductance is approximately 4.5 microhenries. When maximum turns on the primary are used with condenser having a capacity of .009 microfarads, the wave meter shows a reading of 385 meters. Using one complete outside turn or an inductance of about 1.2 microhenries and a condenser capacity of .009 microfarads, the wave meter shows a reading of 205 meters. Secondary inductance is approximately 10.9 microhenries. When using a condenser capacity of .004 microfarads to .009 microfarads, a very select range of short wave lengths can be attained.

WRITE FOR OUR CATALOG "T-20"

PAUL UNIPIVOT GALVANOMETER

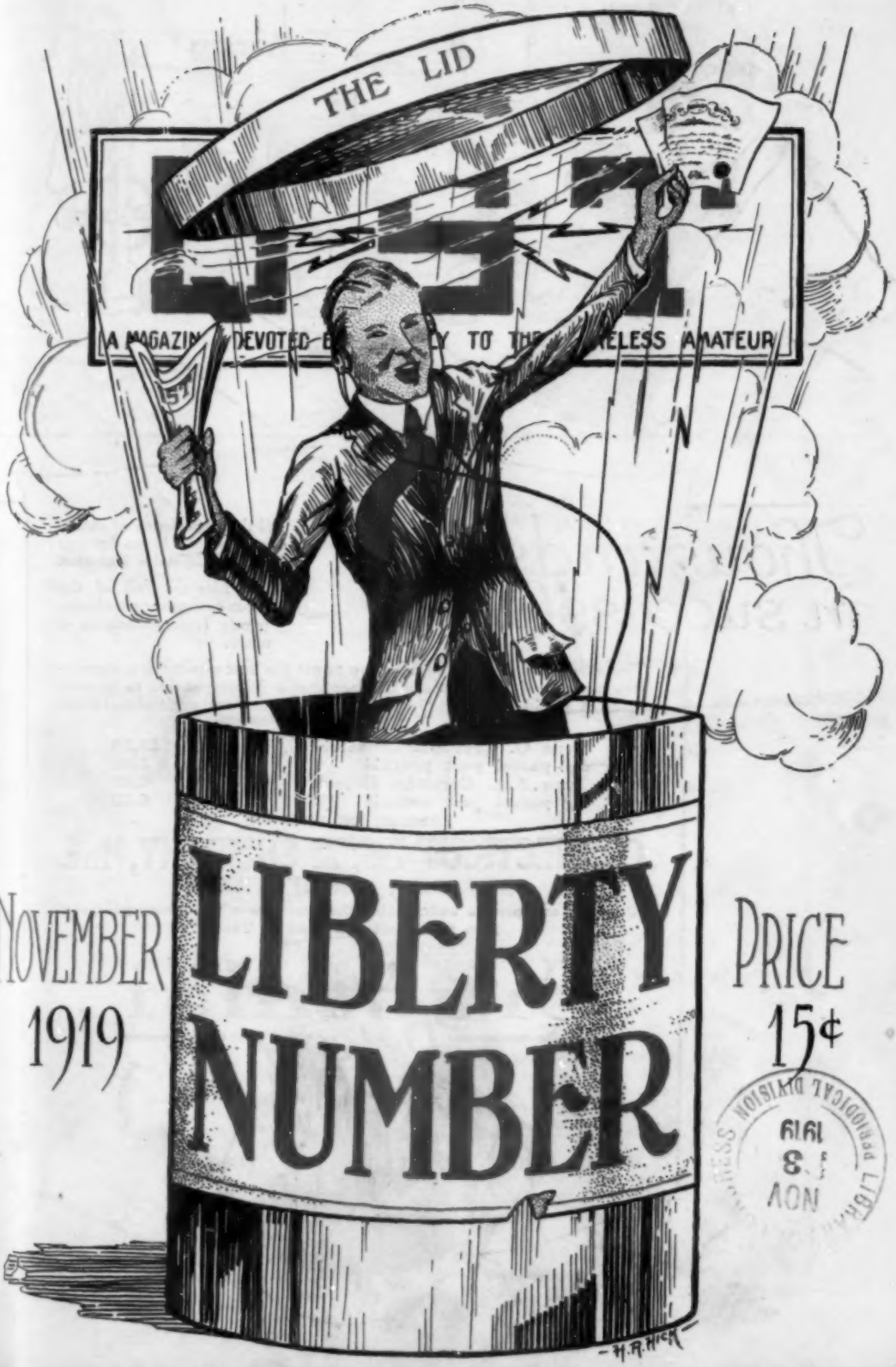
TYPE I

Excellent for wing circuits of vacuum tubes

Resistances of 5, 10, 50 and 100 ohms

Rawson Electrical Instrument Co.

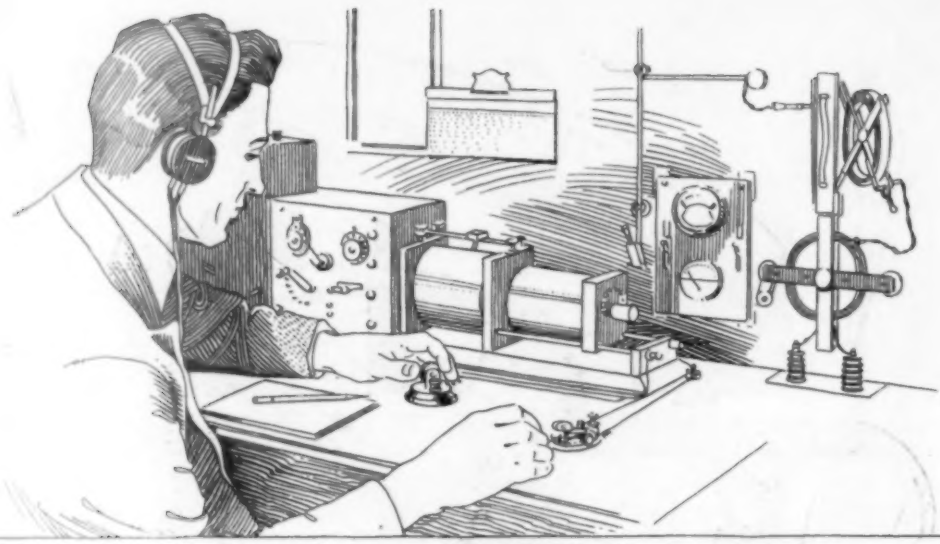
4 NORFOLK ST., CAMBRIDGE, MASS.



NOVEMBER
1919

PRICE
15¢

LIBRARY OF CONGRESS PERIODICAL DIVISION
NOV 3 1919



Thousands in successful use ~

If the experience of others is anything to go by you want a Crystaloi Detector.

Our files are full of the most enthusiastic endorsements from thousands of users.

The ease with which it enables you to get the best quality in a signal—its simplicity of operation and the fact that it is inexpensive to operate make it the ideal Crystal Detector for the amateur and professional alike.

PRICES

Type O. Crystaloi Detector	**$3.50**
By parcel post prepaid	**3.60**
Type A.A. Crystaloi Detector	**6.00**
By parcel post prepaid	**6.20**

BOOKLET ON REQUEST

CONNECTICUT TELEPHONE & ELECTRIC COMPANY, Inc.

MERIDEN, CONNECTICUT

All rights and patents under which the Crystaloi is made were purchased from the inventor, Eugene A. Turney

Crystaloi
Detector

©CL8449125

OCT 30 1919

QST

VOLUME III NOVEMBER, 1919 NO. 4

CONTENTS

3	The Importance of our A.R.R.L.	Hiram Percy Maxim
5	The Champion of the Amateurs	
5	Obituary—Clarence W. Brown	
5	Erratum	
6	The Photo-Electric Cell and Its Possibilities in Radio Communication	Herbert E. Metcalf
9	Rotten Impulse Excitation	"The Old Man"
10	Some Dope on Hook-ups	
12	Getting Your Licenses	
13	Editorials	
17	Calibrating Your WaveMeter	
18	QST Subscription Contest	
22	The Operating Department	
26	Harmonics	
27	Notes on the Quenched Gap for Amateur Use	H. J. Tyzzer
29	Who's Who in Amateur Wireless	
30	U-Boat Radio	J. A. Crowdus
32	"Strays"	
34	The Junior Operator	
36	Radio Communications by the Amateurs	
40	Transmitter Efficiency	M. B. West
42	QST's Directory of Calls	

QST is published monthly by The American Radio Relay League, Inc., at Hartford, Conn. Kenneth B. Warner (Secretary, A. R. R. L.), Manager and Editor.

Subscription price, $1.50 per year in the United States and possessions; Canada, $1.75; Foreign, $2.00. Single Copies, 15 Cents.

Entered as second-class matter May 29, 1919, at the post office at Hartford, Connecticut, under the Act of March 3, 1879.

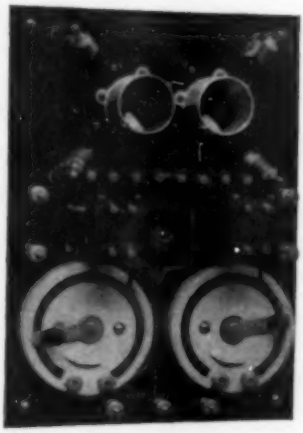
Copyright, 1919, by The American Radio Relay League, Inc.
Title registered at United States Patent Office.

THE AMERICAN RADIO RELAY LEAGUE, Inc.
HARTFORD, CONN.

HAVE YOU CONSIDERED

THAT it *does* make a difference where you purchase your apparatus?

THAT service, a congenial atmosphere and a genuine interest in the amateur—plus a high grade line of radio supplies *must* give real satisfaction?



"TRIODE E"
TWO STAGE
AMPLIFIER
Price $39.00

The illustration shows our New Two-Stage Amplifier—designed for the amateur. A feature of construction is the shock-proof tube mounting eliminating breakage.

Price $39.00

W. S. A. Amplifying Transformer, $7.00

ATLANTIC RADIO COMPANY

34 BATTERYMARCH ST.
BOSTON, MASS.

WRITE FOR
BULLETIN 10

OCT 30 1919

Q S T

A Magazine Devoted Exclusively to the Radio Amateur

The Importance of our A. R. R. L.

By Hiram Percy Maxim

THE removal of all war time restrictions on amateur radio marks the ending of one chapter and the beginning of a new chapter in amateur radio history. The new is going to be entirely different from the old. Wonderful things were brought to pass in the old; but immensely more wonderful things are going to be brought to pass in the new. Before we become engrossed in our new conditions, it is well to consider what are the important things which should govern us.

When amateur radio is examined critically, the fact is borne in upon one that the foundation stone upon which we have built those successes which we have achieved has been ORGANIZATION. Our American Radio Relay League, with its strictly amateur organization, and its ability to represent the better amateurs of the country as a solid body, has exerted more real beneficial influence than is generally appreciated. There is a terrible difference between an unorganized, incoherent, uncontrolled crowd and an organized, coherent and orderly body. One can attain almost nothing. The other can perform wonders, even miracles, if the organization is perfect enough. A tug-of-war team, well organized and controlled can pull off its feet an unorganized crowd of three times its numbers. One acts as a body, a united whole, under formulated plans worked out in advance. The other acts separately, individually, no two pull at the same time nor in the same direction and there are a thousand plans and no control.

We amateurs were an unorganized crowd, any way as regards the country as a whole, before the days of our American Radio Relay League. We had no established national standing, because we had no national organization. There were a good many of us, but we were scattered. We were regarded with mild interest by some, and with mingled tolerance and amusement generally. If it had not been for certain local clubs and associations, who undertook the work of protecting amateur interests generally, there is no telling what might have happened to amateur radio in the legislation of 1912. Reference is made particularly to the splendid work done by the Pennsylvania Wireless Association in the early days.

The importance of organization is splendidly exampled in recent times. We never could have built up our Trans-Continental nor our Inter-State relay systems had we not got together, acted as a National body and worked out the problems systematically. We never could have brought to the Army and Navy the flood of experienced radio operators which we did bring in those first critical days, if it had not been for our National organization. This record will stand on the pages of history more distinctly as the years roll on. It was a noble effort for all concerned, and lifted amateur radio from the realm of toyland to the dignity of a valuable National asset. Our organization made it possible to present the facts from the country's standpoint to a great body of amateur operators

whose method of thought had previously been trained in the right direction.

An example of the value of organization is the vigorous and successful opposition our American Radio Relay League was able to exert in the last twelve months when legislation was attempted by the Navy Department, which many of us think would have made easy the total elimination of amateur radio, if some unfriendly authority desired to do so. Through our organization we were able to bring countless remonstrances from every State of the Union. Congressmen in Washington had their attention directed to amateur radio and had the facts explained to them in an incredibly short time. The pressure of opposition was so strong and was based upon such uniformly reasonable grounds, that the Committee having the proposed legislation in charge actually declined to report the bill out. It died in Committee, and the incident is an example of the value of organization which every amateur should keep in mind and explain to those to whom the value of organization is not apparent. There always are some among us who oppose order and system and constituted authority. As in other walks of life, we must constantly exert ourselves to overcome the unfavorable influence which these sort of people encourage.

There are very impressive examples of the benefits of organization in other activities. Labor is one. It was only able to make its voice heard and its influence felt when organization was so perfected that laboring men became an organized, systematically controlled, single minded body of men. Almost every business had to organize associations for mutual protection. We have manufacturing associations, sales associations, agricultural associations, financial associations, scientific associations, in fact hardly a branch of human activity has not found it either desirable or absolutely necessary to organize for mutual improvement or for protection against elimination. Automobile owners are one of the recent groups of individuals who were most difficult to organize, and yet who had the most to gain from organization. The youngest of us must remember how country constables set speed traps and arrested automobile owners by the wholesale for trivial technicalities. It became a form of piracy which equalled the most prosperous days of the old sea-rovers. It was not until automobile clubs of the American Automobile Association were formed all over the country that sufficient influence could be brought to bear to have just laws passed and unjust laws repealed.

Amateur radio station owners and experimenters are in many cases young men who have not yet been in contact with the affairs of the world. It is difficult for them to realize the supreme importance of organization, and that little modicum of unselfishness that is necesssary in order to bring about perfect organizations. There is no such thing as organization if each one of us starts out to be thoroughly selfish. If all our efforts are to be directed solely for the benefit of self, we are purely individual and able to take about as much form as the individual sands of the sea. We are an incoherent, uncontrolled crowd. On the other hand, if just a little of our efforts is devoted to THE COMMON CAUSE, we automatically establish organization and efficiency and protection, and everything else that is elevating, improving and worth the having. The only thing we have to sacrifice when we organize is that amount of time and effort that is necessary to enroll one's name, and that amount of money that is necessary to pay yearly dues. The rest takes care of itself, automatically. When an amateur asks that old time question, "What do I get out of joining the A.R.R.L.?", the answer should be, PROTECTION. He cannot have it unless somebody joins an organization and does the work. Unless he joins and does his bit, he must not complain when his fellows place him in that list of unenviables who are not willing to do any work themselves but who will accept the results of what the other fellow does.

A most impressive example of the possibilities of amateur radio organization is the results achieved by our Traffic Department. I have been told by outsiders that when the monthly reports of the Traffic

(Concluded on page 8)

The Champion of the Amateurs

FRIENDS, it gives us pleasure to present to you Honorable William Stedman Greene, Chairman of the House Committee on The Merchant Marine and Fisheries, loyal protector of amateur rights, confounder of all government-ownership programs, and for the past twenty-one years Representative in Congress from the State of Massachusetts.

Mr. Greene it was who undertook to present the case of the amateurs in our effort to secure reopening. When our Committee went down to Washington we found a real sympathizer in Mr. Greene. Once he had been informed of the situation he went to work, and within a month—Presto! we are open! It seems only fair now to let out the story of how our reopening was accomplished. We talked the matter over with Mr. Greene and the first step seemed to be to find out why we were still closed, so Mr. Greene prepared and introduced for us a resolution asking the Navy Department to explain the reasons why we weren't opened, and at the hearings on this resolution the House Committee let it be known that they strongly favored our early resumption of operation. As time went by without the appearance of any results from this Mr. Greene again prepared a resolution and introduced it, and this document is one which will ever have a place in amateur history. Known as H. J. Res. 217, it reads as follows:

HON. WM. S. GREENE

"Joint Resolution, to direct the Secretary of the Navy to remove the restrictions on the use and operation of amateur radio stations throughout the United States. Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, that the Secretary of the Navy be, and he is hereby, directed to remove the restrictions now existing on the use and operation of amateur radio stations through out the United States."

Mr. Greene was born in Illinois in 1841 but removed with his parents in 1844 to Fall River, Mass., which has since been his home. Entering politics in the year 1876, he has had a varied and useful career in his chosen field, serving as Mayor of Fall River for seven terms, and twice as Postmaster. While Postmaster in 1898 he was elected to an unexpired term in the 55th Congress, and has since served continuously, being one of the oldest members of Congress in point of service.

We all feel a deep sense of gratitude to Mr. Greene for his splendid efforts in our behalf. Our sincere and hearty thanks are yours, Mr. Greene.

OBITUARY

The death of Clarence W. Brown, of 8ADP, Akron, Ohio, on October 2nd, came as a shock to his many friends, many of whom were radio amateurs throughout northern Ohio and western Pennsylvania.

Mr. Brown was a recent Curtis Aviation School graduate and a licensed aviator, and was one of the members of the Ohio Aviation School, located east of Lorain, Ohio. It is believed that while in the air some control on the plane broke, causing the machine to crash to earth and resulting in the death of Brown and his passenger.

Mr. Brown was quite an amateur radio enthusiast, having been President of the Akron Radio and West High Radio Clubs. Only a day or two before the accident he had erected a station, planning to be in on the A.R.R.L. relaying when the ban lifted.

ERRATUM

On page 4 of the October QST, in the description of Mr. Seabury's oscillator, the capacity of the condenser C4 was erroneously shown as .005 mfds. It should have been .0005 mfds., the same as condenser C3.

The Photo-Electric Cell and its Possibilities in Radio Communication

By Herbert E. Metcalf

We QSTists are a pretty practical bunch, and it isn't often we can indulge in a purely speculative article, but here is one which offers possibilities for development at our hands, and that is what we are looking for.—Editor

THE photo-electric cell, as its name implies, has to do with both light and electricity. It is primarily a device where-by a current is made to flow under the action of light, and in that respect may be compared with a selenium cell. The comparison ends there, however, and in the nature of its action it is far removed from cells of selenium and similar compounds.

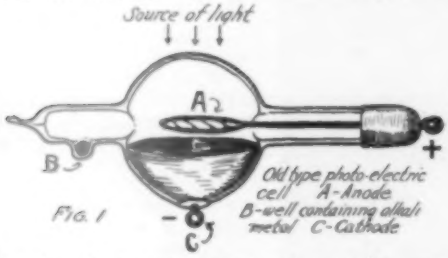


FIG. 1

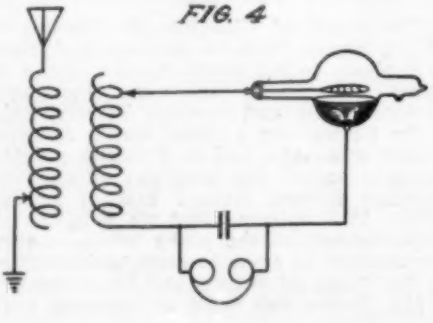
Briefly it is composed of a tube containing two electrodes, anode and cathode, the anode being of platinum and the cathode consisting of a highly sensitized film of an alkali metal in its pure state. Its comon function in the scientific world is in the photometry of stars, for which purpose it has been highly developed by Dr. Jacob Kunz of the University of Illinois, to whom I am indebted for a great deal of the information contained herein.

One form of the cell is shown in Fig. 1. The glass bulb contains a platinum ring on an arm, as an anode (A), and one half of the bulb has been silvered, making a hemi-spherical mirror. The tube is highly exhausted on a mercury pump, and then a small quantity of a pure alkali metal (sodium, potassium, etc.) which has been included in a small well in the tube (B) is carefully distilled onto the silver mirror. This is accomplished by having a heating coil which heats all the glass to above the condensation temperature of the alkali, except that portion where the metal is to be deposited, which in this case is of course the silver mirror. That portion of the cell is kept cold by means of a water bath in order to hasten the condensation of the metal. The most sensitive cells are those in which the metal has been deposited on the mirror in a thin uniform layer. Then the layer must be sensitized. A platinum wire sealed into the glass in the center of the mirror makes contact with the deposit, to form the cathode. With a potential difference of from 280 to 400 volts between anode and cathode, pure hydrogen is admitted and its pressure so adjusted as to produce a uniform glow discharge at this voltage. During this glow the surface of the alkali metal is undergoing a change and a hydride is forming. This development must not progress too far, and the sensitiveness is continually tested while the hydride is forming. When the proper sensitivity is reached the hydrogen is pumped out and an inert gas such as argon, helium or neon is admitted, for the purpose of maintaining the stability of the combination. The best combination for maximum sensitivity is a cell made from rubidium, sensitized with hydrogen, and filled with Neon.

So much for the actual construction of the cell. Its action is very simple. When a potential is applied to the "plate" of about 300 volts positive, any small amount of light falling on the sensitized film will cause a deflection of a galvanometer inserted in the plate circuit, and changes in the amount of light will be indicated. The device is so sensitive that by allowing the light of different stars to fall upon the tube their brilliancy can be accurately compared.

The space within the tube, while not a vacuum, is not a conductor, and the current flow seems to be electronic. This view is supported by the fact that originally the

FIG. 4

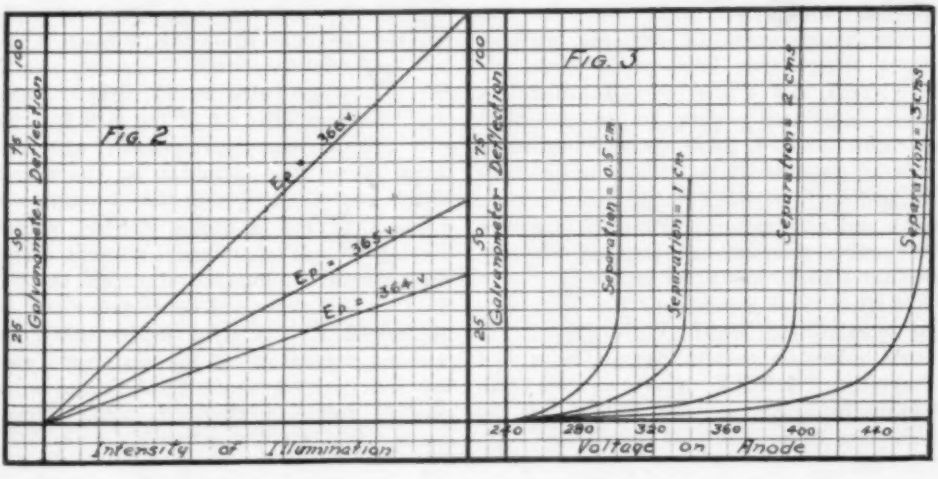


tubes were made with a vacuum and later the discovery was made that the presence of the gas lent stability to the hydride. From this we might say that the hydride layer emits electrons under the impact of light and ionization by collision is also probably a factor. It is not surprising therefore, that curves comparable with the plate-current—filament-current curves of a two-electrode vacuum tube at various plate voltages can be made of the photo-electric cell, in the latter case showing the relation of plate current to intensity of illumination. This is depicted in Fig. 2. The abscissae are distances in centimeters, varying from 40 cms. to 300 cms. between the cell and a 388 c.p. tungsten light. In Fig. 3 are shown several plate-voltage—plate current curves at a fixed illumination, the different curves being obtained by varying the distance between electrodes. These curves may be likened to vacuum tube curves of the same kind for various fixed filament currents.

The sensitivity of the cell as it exists at present may be expressed by the assumption arrived at mathematically by J. G. Kemp (to whom credit is due for the above curves) that by using a tilted electroscope of sensibility 10^{-15} amperes, the light of a candle could be detected at a distance of 2.7 miles.

Some work was done by the author to determine whether or not this tube contained any great possibilities for use in radio reception. It has already been used and described by Kunz (1912) as a rectifier and detector, used in place of a crystal detector, exactly as the Fleming valve, with no plate voltage. See Fig. 4. This hookup was tried and very good results obtained, provided a strong light was allowed to fall on the tube. If the tube was in the direct sun, with no plate voltage the signals were fully as good as the best crystal detector, and of excellent quality, sounding like those from a tube detector rather than from a crystal. It is unfortunate that an oscillograph record of its rectifying qualities could not be made, but it is hoped that this may be done in the future. In this hookup the tube was extremely sensitive to light, the strength of signal being easily changed by walking between the tube and the window, when out of the direct sunlight. When a slight voltage is applied to the plate, the reaction to light is greatly increased but the strength of signals is unchanged or slightly decreased. The curves of Fig. 3 show an extremely abrupt change in plate current at a very critical value of plate voltage, but the difficulty of practical utilization of this feature lies in its very criticalness, which no doubt accounted for the writer's failure to obtain increased signal strength with the use of a plate potential. If the axis of operation could be definitely located in the region of one of these bends, the sensitivity as a detector would far exceed that of present three-electrode vacuum tubes. If the tube is exposed to the direct sun, with a small positive potential on the plate, and the hand passed between the sun and tube, a dull thud may be heard as the current drops and rises again after the light is readmitted. The experiment was tried of placing an electric fan so that the revolving blades would interrupt the light, and in this way a note in a telephone receiver was obtained varying from zero up to and beyond audibility, as the fan speed was increased.

The main drawback with the tube at present is that the actual current in the cell, using a considerable plate battery, is very small—of the order of micro-amperes instead of milli-amperes as in an ordinary vacuum tube. Recently, however, a tube



was designed by Dr. Kunz which gives considerably more current and may be made even larger so that currents approximating those in modern vacuum tubes may finally be obtained. This design is shown in Fig. 5, and it will be noted has a plane aluminum disc bearing the hydride film, and a circular aluminum plate provided with a screened central aperture to admit the light rays. The closer spacing of the electrodes reduces the internal impedance, and with the larger surface it would appear that hope might be entertained for eventually securing a greatly increased plate current with moderate anode voltages. Some work was done by the writer which indicated that this tube might be used as a true relay detector by the introduction of a grid. A measurable control from an exterior grid was observed, but not sufficient to use in the reception of signals or to take curves. The possibility also exists of having the incoming voltage vary the potential across a fine lighted filament furnishing the illumination, and so cause responses from the cell.

The possibilities suggested by a study of this cell are many. The writer has already produced an alternating current in the plate circuit by rotating a fan in front of the cell. Might not some means be hit upon to produce radio-frequent oscillations? Would this cell produce radio-frequent oscillations if exposed to a radio-frequency spark discharge from a capacity? Would not the cell as it is make a wonderful detector for telephonic transmission over a beam of light? The writer believes

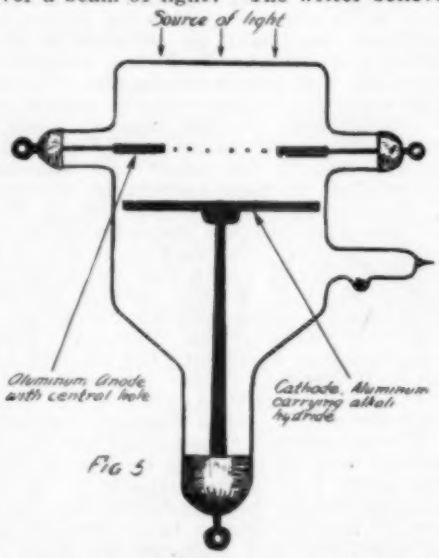


FIG 5

that with proper research the photo-electric cell can be developed to a point of great value in many and various ways in radio communication.

The Importance of our A. R. R. L.

(Concluded from page 4)

Department in QST are read, it is difficult to believe that a stage has been reached such as described. The fact that in the great areas of the far western States, where they have miles where we have yards, and where the population is a single individual where we in the East have one hundred, there are well organized lines of amateur radio relay stations fills the ordinary person's mind with amazement and admiration. We ourselves who have seen this organization of stations gradually form itself, do not fully appreciate what it all means, and the far reaching possibilities which it suggests. It would indeed be rash to attempt to predict where our A.R.R.L. relay system will eventually bring us. It is one of the wonderful by-products of democracy. Up to the time that we amateurs began relay work, the limit which one could transmit intelligence without paying tribute either to the Government or the Western Union or the Postal Telegraph Company, was the distance one's voice would carry. Today, we American citizens of the A.R.R.L. and our friends may communicate with each other from the Atlantic to the Pacific Coast and from within the Dominion of Canada to the Mexican Border, without paying tribute to anybody, without costing any money, and purely through the fact that we are organized to do this work. It is indeed a wonderful achievement, and assures the safety of the statement made earlier, that very wonderful things indeed are to come in amateur radio. Organization will guarantee them.

Rotten Impulse Excitation

By The Old Man

SO you want some comment from those who have had experience with Impulse Excitation? Well Son, I have had experience, and I say right here and now, that if Impulse or Outpulse or any other kind of Pulse will get a full size kilowatt into a 200 meter wave without blowing a hole through something, you can count upon yours truly for any and all the comments you want. Comment! Why, say boy, I would be ashamed to say what my comments would be like, if I could only get a full count of a thousand of those little watt things into a 200 meter transmitter. Comment is easy; but eight honest amperes radiation on 200 meters is not so easy.

This Impulse Poison soaked into my system against my will after reading your dope in October QST. I wonder if you know how much harm you do, and how much trouble you cause, passing out this sweet sounding stuff. If it gets an old bird like me once in a while, what does it do to these young things who have not yet traveled the long and dusty radio road? Your song sounded so sweet and easy that I just could not keep from thinking about it. No resonance—any old "whale of a condenser"—any old amount of power—no reason why there should be any limit to radiation on 200 meters. If that bait don't catch both old and young, then I miss my guess. All you have to have is a rotary gap that will quench. All you have to have to quench is a gap that buzzes around so spry that the closed circuit only has time for one healthy wiggle. So simple!

I had a conviction that my Old Betsy was the kind of a gap that would quench or do any thing else that was noisy. Could it be that this simple little expedient would give me those precious eight amperes I had been longing for all these years? Old Betsy certainly was some gay little twister, and your dope certainly stated in distinct language that if a rotary twists around fast enough so that the plugs get to dodging one another smart enough, the job is done. Only one or one and a half oscillations have time to enjoy their brief career in the closed circuit, while the antenna and the O.T. secondary go on about their own business and give you the pure wave and all the other nice things. I decided to see what Old Betsy could do, what a real man's size condenser could do, and what a real full sized kilowatt could do. Maybe I would see the old H W.A. pointing at eight amperes after all.

I greased the old girl especially carefully, trimmed her plugs until they only cleared by a few thousandths, took half an inch out of her driving belt, and got her so she simply yelled bloody murder. Good Lord, how she did twist around. By the sound, those plugs sure were dodging each other. In fact, I kept dodging myself, thinking any minute the plugs might be after me, being somewhat confused on account of dizziness, as to who was playing in this dodging game with them. Then I put in six condenser jars where two was the legal limit if we confine ourselves to old fashioned resonance between closed and open circuits. These six condensers would be a "whale of a condenser" all right, and would make my wave length in the closed circuit somewhere in the neighborhood of 500 meters, with an ordinary spark gap. This ought to give the secondary of the O T. something of a whallop all right. Maybe things would not be in resonance, but then Impulse Excitation was to attend to this little discrepancy. Maintaining four turns in the O.T. secondary would keep me out of trouble with the Department of Commerce.

When I started her up, the little wife ran out into the back yard, where it was safe and called to me to state my intentions regarding the future of herself and the rest of the family. I didn't blame her, because that cellar was quite a noisy little corner. Everything was boiling hot if it wasn't red hot. Old Betsy was screeching for blood at the top of her cat voice, the condensers were squirting blue fire all over the place, and the transformer safety gap was going off every now and again like a machine gun in a reckless state of intoxication. Judging by the clatter, I ought to be getting around eighteen amperes, and I felt some elated.

When I got up the nerve to stand close enough to throw the H.W.A. switch, I found that I was radiating just a little over one-half ampere. Everything had turned out just exactly the way it always does in radio. Instead of getting eight amperes I wasn't getting eight-tenths of an ampere, and you could hear the racket in the next county. Before shutting her down, I was enough of a hero to reach over and change the O.T. primary to about three-quarters of a turn, and the O.T. secondary to every doggone inch there was in the thing. This was a sacrifice on the altar of resonance. I thought, before the whole business tore itself to pieces, I would at least try it as near resonance as I could

get. It raised the radiation to close on to six-tenths of an ampere. Then I shut her down and went outside and lighted the old pipe.

Some pretty little efficiency, this Impulse Excitation hook-up. With all the O.T. primary out that I could get out and still have it bear some resemblance to an O.T. primary, and with all the O.T. secondary in, that there was to put in, and with close up to a kilowatt going into the transformer, and with six big fat Marconi Leyden jars, and with Old Betsy just splitting the welkin, I was getting very close to half an ampere radiation in my antenna. Then the old pipe began to get in its work. Suppose now, we forget the impulse excitement for a while and suppose we take out two of the condenser jars, and then suppose that we lower the transformer input down to about one-half kilowatt, which is all that will not spill at the safety gap. Supposing also, we bring the O.T. secondary back to four turns which gives us 200 meters, taking advantage of our ten per cent allowance, and suppose we give the O.T. primary a chance for its white alley by putting in, say two turns. This would be somewhere near resonance. What would the result be? Of course, there would be only half as much power input, and we could not expect a whole lot of improvement. But just the same, why not see just how much improvement there would be? So spake the old pipe.

Back to the cellar. Out with sixty-six per cent of the condenser capacity. Down with fifty per cent of the transformer input. Back to four turns on the open circuit. Try her with two turns on the closed circuit. Start her up, stand back from Old Betsy, and when she reaches her top note, throw in the H.W.A. switch. We smiled, the old pipe and I. Three and one-half amperes radiation. Sliding the O.T. primary clip back and forth finally made it three and three-quarters amperes radiation. Say boy, how about it? Half as much input and three times as much output!

Has anybody any comments to make? If he has, let him shoot. Is there any more swan-song business? Don't monkey with the gap, because my Old Betsy is a quick mover, and I don't believe one can be made that will be much quicker. Give us something about resistance in the closed circuit, or booze inside the gap, or two or three gaps in series. I suppose I will fall for it, along with the others. It's just awful what a man will do in the hopes of getting one K. W. into 200 meters.

T.O.M.

SOME DOPE ON HOOK-UPS

THERE seems no end to innovations in undamped circuits. In Figure 1 is presented an idea for an oscillating hookup which may be employed to advantage by those of our readers who possess "Jumbo"

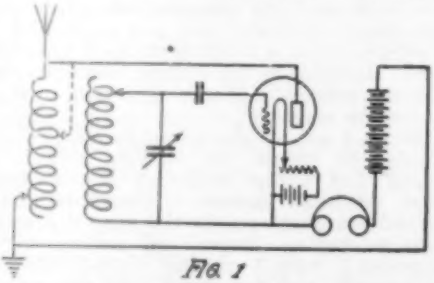


Fig. 1

loose-couplers for receiving long waves. This circuit was sent us by Mr. A. Dean Snyder, of Philadelphia, who chanced upon it while endeavoring to improve upon an oscillating circuit which, in the Philadelphia district at least, is generally known as the Chambers circuit, and was published in QST for August, 1916. This Chambers circuit, also designed for use with large loose-couplers, has the merit of extreme simplicity, differing from the conventional audion hookup only in the presence of a metallic connection from the antenna end of the primary to the plate of the tube. Mr. Snyder's circuit utilizes the primary inductance as the tickler, it will be noted, and is simply a clever means of accomplishing an inductive feedback without the use of a third inductance. It would be well to insert a 2 mfd. insulating condenser in the ground lead. This circuit is reported to be extremely stable in operation and will oscillate over the entire range of the coupler. While the work Mr. Snyder has done with it speaks for its efficacy, it is regarded as desirable that the degree of feedback be controlled, and this could be simply accomplished by the use of a second slider on the primary, as shown by the dotted line.

There are of course an infinite variety of undamped hookups, and we can now make our inductances or choose from several makes of manufactured ones, and can employ either inductive or capacitative feedback to obtain ocsillations. The favorite circuit seems easily to be the old reliable tickler arrangement (Fig. 4, page 4, October QST) with three coils. We wonder if any purchasers of deForest honeycomb

coils are employing the deForest three-coil anti-static circuit? Correctly handled, this circuit is surprising in its selectivity and freedom from static but in general is not nearly as effective as the tickler circuit. We imagine it is advocated only on account of patent reasons, the tickler hookup being an Armstrong circuit which the deForest people cannot advertise, and that they trust in the intelligence of the purchaser to discover that the "three-coil mounting" lends itself admirably to the use of the latter circuit, employing the stationary coil as the secondary, with movable primary and tickler on either side.

While good results may be had by tuning the plate circuit by means of a capacity around the tickler, this method is uncommon and the more satisfactory method is to eliminate the condenser and let the plate circuit function aperiodically.

A word about amplifiers. Resistance repeaters are unsatisfactory for short waves. Impedance repeating is better and two-winding transformers best of all. The latter make possible a judicious choosing of input and output impedances to suit the tube characteristics, but more important is the fact that, as the tube is a potential-operated device, amplification comparing favorably with that of the tube can be obtained in the transformer itself by the use of a step-up ratio. This naturally depends on the tubes and should not be so great that the variation in grid voltage causes the changing plate current to reach either bend in its characteristic curve, or distortion and blocking will result, and particularly is this likely in the last stages of a multi-stage amplifier. It might be well, therefore, to employ a reduced turns-ratio for the extra steps; For example, a 1-to-4 ratio for the first tube, and a 1-to-2 ratio in the others. Obviously, however, we aren't likely to be bothered by blocking when amplifying very weak signals, but iron losses preclude the use of very high turns-ratios.

The Federal amplifying transformers employ 3900 turns of No. 44 enameled wire on the primary and 12,000 turns on the secondary, giving a ratio of slightly over 3. The Acme transformer has 4000 turns primary and 15,000 turns secondary, all of No. 40 enameled; the primary impedance is approximately 1000 ohms and that of the secondary nearly 6000, these values being obtained by winding the primary under the secondary. This latter point it is well to note, for since the secondary turns are of larger diameter, an impedance value more appropriate for the tube can be secured without excessive turns. With some tubes the desirability of securing correct values of impedance offsets the value of a voltage step-up, and Mr. A. H. Wood, Jr., of the Clapp-Eastham Co., has supplied us with the specifications for a transformer embodying a lower turns-ratio with which excellent work has been done. This transformer has a core of outside dimensions 1⅜" by 2½", built up ⅜" square with well-shellaced iron laminations. Primary and secondary are wound on the same leg, secondary over the primary. Primary has 7,000 turns of No. 38 enameled wire, and the secondary 10,000 turns of the same, each layer being separated by a strip of oiled paper 2 mils thick.

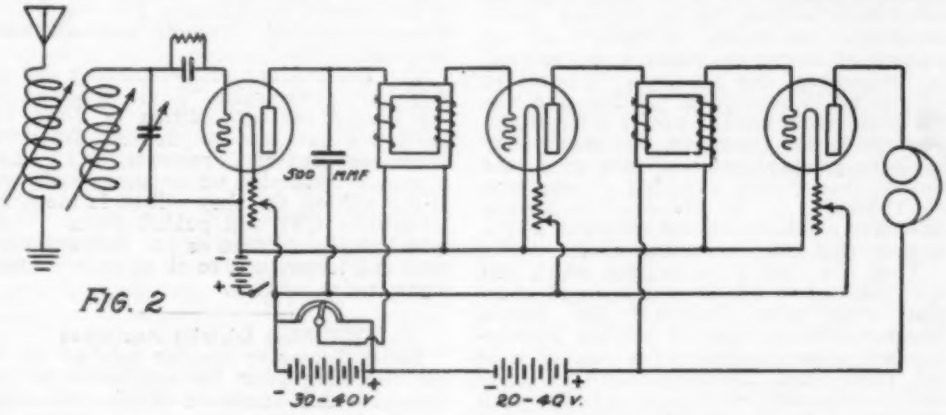


FIG. 2

There seems to be little to choose between the AudioTron and the Class I Marconi tubes in sensitivity as a detector. Both contain a small amount of residual gas and both therefore require adjustable A and B batteries for best results. The higher vacuum tubes, such as the Class II Marconi, are preferable as amplifiers; such a tube does not require adjustable batteries but functions better on the higher ranges of plate potential, say about 60 volts. In response to numerous inquiries we show in

(Concluded on page 17)

Getting Your Licenses

HAVE you got your licenses so you can start operating? If you haven't, here's what to do and how to do it:

First, an operator's license, without which you cannot operate a station. If you have an unexpired commercial operator's license, you are fixed, but otherwise you'll have to be re-examined, as all pre-war amatèur licenses have expired. We strongly urge that if at all possible you secure an appointment with your district Radio Inspector and report in person for the examination, so as to secure a first-grade amateur license. Provision is made, as in the past, to issue second-grade licenses to amateurs remote from the Inspector, but those within fifty miles are expected to apply for a personal examination; and, besides, there is much more satisfaction in having a "first", to say nothing of saving the delay in its receipt. In "cramming" for the quiz, we want to tip you off to something. Before the war the Department used to prefer brief, direct answers to the questions, but that policy has been changed and now they go on the theory that "what you fail to say you don't know"; so be prepared to answer questions explicitly and at sufficient length to show that you know all about it.

Then the station license, for which you are qualified to apply as a licensed operator. Ask your Inspector for forms. These application blanks call for description of various technical features of your set, from which the Department of Commerce ascertains whether it complies with the law in certain respects. Another tip: be very certain that you don't make the mistake of showing dimensions for your proposed antenna which will total more than 120 feet for the sum total of flat-top length, vertical portion, lead-in, and ground-lead to point of actual contact with the ground, or right on the face of things your set can't comply with the law and your request for a license will be denied. (If you can't report in person for the operator's examination and have to write for forms for second-class operator's license, ask at the same time for station license application blanks, and send both back together.)

Unfortunately, just at this time the Department is very short of clerical help in their various offices, and this is likely to cause delay in issuing station licenses. The Radio Inspectors are authorized, however, to advise applicants what call letters they will eventually receive on their licenses and authorize them to commence operation at once, using their official call, without awaiting receipt of the actual license. It is imperative, however, that you have either the actual license or due authority from the Inspector to operate pending its receipt. We don't want any unauthorized transmitting using initials for a sig, etc.

Familiarity with the radio laws is required before an operator's license can be secured. The information is contained in a publication entitled "Radio Communication Laws of the United States", including all the regulations under which the Department of Commerce's Radio Service operates, and also the London Convention, etc. If you haven't a copy, send 15 cents by postal or express money order (stamps will not be accepted) to the Superintendent of Documents, Government Printing Office, Washington, and acquaint yourself with the regulations.

The Department of Commerce's list of ship and commercial "Radio Stations of the United States," edition of June 15, 1919, can now also be procured from the Superintendent of Documents, at 10 cents a copy. Naturally no amateur calls are in this edition, tho they will be in the next. Meanwhile QST will publish them. Drop us a line just as soon as you find out what your call letters are, so all of us will know whom we're hearing.

QST First District Amateurs

Radio Inspector Gawler advises us of the following rules for applicants in this district. All amateurs within 40 miles of Boston must appear in person at the Custom House there for examination for first grade amateur license, on any Saturday, which day is given over to examinations for this grade. Out-of-town applicants for such examination will be considered on other days, but Saturdays are preferred. Blanks for this grade can be obtained only at Custom House—do not ask for them by mail. Holders of expired amateur licenses will have their choice of taking 12 words per minute with the written examination waived, or 10 words per minute and the regular examination.

Amateurs outside the 40-mile zone around Boston can obtain examination by writing the Radio Inspector for blanks for second grade amateur license, also requesting station license blanks at the same time. Examinations for this grade are conducted by mail, and if successful, licenses will be mailed and call letters assigned promptly.

AT LAST!

Just as we were ready to mail last month's issue, the word came from Washington that the Navy Department had cut the ropes and removed restrictions on amateur transmitting. After throwing everything within reach at the office boy, and finishing off by jamming the waste basket down over his head, we grabbed the telephone and told the printer for the love of Mike to make room for an emergency sheet to go into every QST, and that we would pound something out immediately and be over in ten minutes. Talk about Impulse Excitation! We were both impulsive and excited. It seemed like the coming true of a dream. To realize that we could call up and holler QRT and QRM and do all of the other things that we had been longing to do since April, 1917, made it difficult to focus properly.

The far reaching effect of the removal of the ban on transmitting cannot be estimated. Probably every amateur in the country got as excited as we did here in the editorial sanctum. Maybe they didn't throw things, but if they were real dyed-in-the-wool, blown-in-the-glass, all wool and a yard wide radio bugs, they wanted to. These amateurs are going to make the removal of the ban on receiving look like a half-inch spark coil that has been rained on. Receiving is all right, but it is not to be compared with receiving and transmitting. It is the transmitting that makes amateur radio what it is. The removal of the restrictions is going to be felt in every line of business from the lumber yard to the instrument maker. The Old Man's electrical supply store will have to order soldering paste by the barrel and the hardware stores are going to note a marked increase in the demand for everything from nails to copper wire.

But there is another side to this fair picture. A lot of us are going to find that some pet scheme is not going to work any where nearly as perfectly as we expected it would. Instead of radiating five amperes, it is going to be three-quarters of an ampere, or the tone is going to be ragged or the coupling has got to be looser, or the insulation about five times better. We are not going to have the air chock full of QRM right off quick. It is going to take time to get back, and a terrible lot of good hard work. But that is where we amateurs shine. All of the troubles will be gradually fixed up and transmitting distances that we never dreamed of are going to be matters of every day occurance. The days of real sport are at last with us. Come on, fellows, and get into the air again.

QRM

On your life, don't cause interference with commercial or government stations!

Reopening wasn't won easily, and we believe the chief obstacles which delayed it were twofold; a mistaken supposition that all amateur activity was a kind of

child's play, withal interesting but lacking in practical value or serious moment, and second and far more important, that the amateurs were likely to interfere with commercials or government business. We all know that an amateur station complying with the law as regards wavelength and decrement can not interfere on the higher wave lengths and this we have ever lustily maintained. But now that we are open, the powers that be have an extremely watchful eye in our direction, and we are absolutely on our merits. If we interfere, we play right into the hands of the Navy Department and give them the strongest argument against us which could be devised.

Let all of us be continually on our guard that this does not happen. Do not take a chance—know what your wavelength is, make sure it is not over 200 meters, and comply with the law. Help the Junior Operators in your neighborhood to have law-abiding stations, by counseling them in the erection of their antenna and the tuning of their sets. In particular watch the decrement! If your coupling is too tight, you are breeding a mess of trouble for all of us, and here's why: Altho your circuits may be carefully tuned to 200 meters, too close coupling causes the radiation of two tunes, one less than 200 (and inconsequential) but the other above 200, and just how much above you do not know without a wavemeter. It may be 300, it may be 450, it may be 600 and smack on the commercial tune, and if so it will surely cause interference. Not only that, but in such a case the tune is inevitably very broad and the signals cannot be tuned out. Trouble for all of us is sure to result, and the good name of amateur radio will suffer. Remember that the only satisfactory way to tune a set is with a wavemeter, first tuning the circuits to resonance and then employing the wavemeter in what is far more important—the determination of the proper coupling, not so loose that energy transfer is hopelessly inefficient but just at that nice degree where the two "humps" merge into one. Then there can be no trouble.

Let this thing get home to you, fellows. We make or break ourselves now. It is the actions of the individual operator which, summed up, make the whole of us—constitute the amateur field. If only every operator will do his part we will be jake. The standard of amateur knowledge has soared like the aviation altitude record since the pre-war days, and we should be heartily ashamed of a station that interferes, either due to the character of its emission or on account of the perversity of its operator. Let each and every loyal A.R.R.L. man constitute himself a Deputy Inspector. Keep out an eye and an ear to the activities in your neighborhood, and do your utmost to keep things up to snuff, wherever they come under your observation. If a station in your vicinity emits an unlawful wave and the operator is deaf to your admonitions to correct it, we counsel reporting him immediately to the Radio Inspector. Don't get the idea that this is "snitching." There can be no possible defense—not one shred of protection—for the amateur station which refuses to comply with the law, and we are all likely to find ourselves in trouble if these operators cannot be made to see the light of reason. So appoint yourself a Deputy Inspector to act for the good of all amateur radio—but be reasonable!

And on your life, don't cause interference with commercial or government stations.

OH WHERE, OH WHERE?

In the August "Wireless World", published in England, appears a short article on the British amateur situation in which the writer expresses grave fears that if the British amateurs are reopened their desire to use audion detectors will cause wholesale interference of a brand-new, startling and distressing type. "The thought of fifty valves, all oscillating unknown to their owners, howling in fifty different sharps and flats, all less than five miles from a wireless telephone station or a research

laboratory, is disturbing enough", apparently, to almost make the author "put 200 v. on the grid."

Just exactly where that advanced knowledge comes from we aren't able to puzzle out. We can't find a thing about it in our treasure-house. In fact, we rather get the impression that the gentleman isn't altogether in favor of seeing the restrictions on the British amateur removed, deep down in his heart. Perhaps that accounts for a rather extraordinary ability in the finesse of deprecation, otherwise "crepe-hanging."

Oh Mister Man, tell us how an amateur, Britisher or anybody else, can hope to receive spark signals on a tube, and preserve the musical characteristics, if he has it oscillating. And we're almost sure we've read somewhere that audible notes are produced only when oscillations of two impinging frequencies differ by such a value that the resulting beat frequency is within the range of audibility, so that we can't quite see how interference would be caused by the radiation of the most ungentlemanly-oscillating detector tube of a British short-waver beating on the oscillations of a government station in all probability tuned to several times the wave length of the amateur. Or perhaps they have operators over there with radio-frequency ears. And we can't quite gather how the gentleman expects to receive telephonic speech on an oscillating tube; oscillating, for otherwise we aren't inclined to believe he'd have a beat frequency in his receiver. Or, tell us, Oh Seer, maybe in England two ham sets can beat on each other and produce an audible howl and the audio-frequency will be propagated five miles and give you QRM on a commercial wavelength. Honest, you have us there—we didn't know it could be done.

SPECIAL LICENSES

The subject of special licenses is again in the minds of many of us, and no doubt the Department of Commerce is being deluged with applications of this nature, no appreciable percent of which can be granted.

Just how ought we to regard the issuing of special licenses? Should we all rush in and promiscuously ask for a special? That amounts almost to changing the standard amateur wavelength from 200 meters to 425. Isn't it a fact, tho, that the holding of a special license has been the ambition of many an amateur? And just exactly why? We doubt if the average amateur can put up a logical argument why he should be entitled to the privileges of a special license. Wouldn't it be well for us to talk this thing over among ourselves and decide what we think the purpose of a special is, and under what circumstances it should be issued? Discussion always brings out the kernel in such topics, and so we're willing to start the ball rolling.

The first question is, is there any advantage in possessing the privileges granted by a special license? As we see it, there is; not because the wavelength is different but because for 425 meters a condenser can be used of so much larger dimensions that increased power can be utilized, and that is an advantage. The limitation of general amateur stations to a transformer input "not exceeding 1 k.w." is ludicrous for 200 meters, because the wavelength requirements so restrict the size of the condenser of such a set that it is impossible to utilize over 700 watts with an efficient transformer, using anything like ordinary secondary voltages. So we conclude the special license does have its advantages.

On the other hand we must remember that it is provided for use only in exceptional circumstances, and that brings us to the next point, which is "Who by rights ought to have special licenses?" We see several things: Very good work can without question be done on 200 meters, so that it is proper that 425 meters be reserved for exceptional cases. East of the Mississippi River stations are so thick that the exigencies of relay work and the demands of ordinary amateur experimentation do not call for it, and the congestion is such that extra power causes disproportionate interference. The farther east we

consider the more emphasized this condition becomes, and in particular along the North Atlantic Seaboard and also the California Coast we can see no logical reason for the issuance of any quantity of special licenses, as stations are thicker, relaying easier, interference possibilities worse, and especially inane is the risk we take in interfering with ship-to-shore work if specials are issued wholesale in this part of the country. There is very decidedly a place for them, however, and that is in the territory west of the Mississippi where stations are few and far between in a land of "superb distances." Relay work has been difficult thru this country just because of these facts, and it is notable that what work was done was possible only because of the fortuitous location of a small handful of excellent stations at strategic points, and certainly in these circumstances anything which will in any wise improve operating ranges is extremely desirable. And right there is the secret of the whole thing: It is for exactly such work that special licenses are provided, and it is our humble opinion that their issuance ought to be restricted to cases of this nature where the spans to be covered make it necessary if successful work is to be done, and where the possibilities of interference are minimized.

We have been assured that discrimination is to be employed in the issuing of post-war special licenses, and if there is any logic in the foregoing paragraphs wouldn't it be well for us to take note of the handwriting on the wall and adjust ourselves to it by preparing to forego applications for specials whenever all the necessary work can be done on 200 meters?

THE SINEWS OF PEACE

The psycho-theologists tell us that Heaven is a state of consciousness. That being so, every real amateur these days should be browsing around the 'steenth Plane in a state of wholly joyful bliss. Howzat? Just consider the wonderful array of splendid amateur apparatus which greets our reopening. Everything that we can think of is available, and all the practical developments of the art during the Great War have been embodied in the amateur lines presented for our selection at this time. The energies of large corporations who built up organizations of personnel and machinery for grinding out war contracts for government radio apparatus have in many cases now been diverted to the production of equipment for us; during the period of our inactivity the old-timers were busily engaged in keeping up with improvements and embodying them in the new lines which they should present when better days appeared on the horizon; so that now the Dawn of the New Day in Amateur Radio reveals a perfectly dazzling array of apparatus, past our dreams and so far removed from the stage in which the declaration of war found us that there is no comparison.

You've been feeling much this same way, haven't you? So that we don't have to say much about it to bring to mind that we are better equipped than ever before to do startling things in the field of amateur operating. More and more every day we see the limitations of intelligence of whoever attempts to prophesy what we will be able to do this coming winter or what we won't. We don't even dare to say that the sky's the limit for us.

Ever stop and think how apparatus is bound to sell now? We are on the verge of a most tremendous boom in the sale of equipment, for the pent-up schemes of all the hundreds of thousands of station owners are set free by our reopening and we know that the business of buying money orders to pay for instruments is going to give Mr. Burlesque's Post Office Department a lot of QRN. We are heartily glad to see our manufacturers coming into their own, for they are deserving of every good thing at our hands, and they've been mighty faithful to our QST. But murder! isn't apparatus going to sell like icicles in Hades; and don't we know some mail-openers who are going to have headaches! Get on to this new apparatus on the flood

tide, for you need it in your business. Write for the catalogs and then prepare your station for the busy season that is ahead of us.

Which brings to mind another little memory-jog, fellows: Whatever you do, don't forget to mention QST. We comprise the great buying public, and the manufacturers and dealers like to know just what moves us to write them. And it helps our QST immensely, for you know our advertising depends on the results QST produces and we must feel it a solemn duty never to overlook giving QST the credit when we write our advertisers. The more results QST gives them the more our advertising will increase, and that's where the money comes from that produces QST. By never failing in this respect we will soon climb up to where we can afford a 132-page QST (visions of joy!) and even that isn't the limit of the ambition of us here at headquarters, by a darned sight.

Calibrating Your Wavemeter

THE Radio Laboratory of the Bureau of Standards is equipped to calibrate and test radio instruments of various kinds, charging a nominal fee. The particular feature which interests us is the opportunity afforded to get our home-made wavemeters accurately and inexpensively calibrated.

For precision wavemeters a charge of 50 cents is made for each point taken in the calibration, with a minimum of $2.50 for each coil, as many readings being taken as desired, and of course the more the points the greater the accuracy. A reduced fee, however, is provided for amateurs, and in the case of wavemeters not suited for precision measurements submitted under the above-mentioned schedule the Bureau will charge a minimum fee of one dollar per coil. Enough points will be measured to give a calibration curve consistent with the optimum accuracy of the instrument.

Another facility which interests us is the taking of curves on tubes, and the Bureau is prepared to do any class of work in this line. The fee for taking the first characteristic curve of a receiving tube is $4.00, and $2.00 for each additional curve on the same tube. Amplification constants and internal resistances of receiving tubes will be measured for a fee of $2.00 for the first determination, with $1.00 charge for each additional determination on the same tube, etc.

Apparatus submitted to the Bureau for testing should be provided with identification marks, and shipped prepaid to Bureau of Standards, Washington, D. C., accompanied by a written request for the test, enumerating the articles, stating their identification marks, and setting forth explicitly the nature of the test desired. It is desirable that the conditions under which the apparatus is used be stated, and in the case of precision wavemeters the number of points on the scale at which the apparatus is to be tested. Fees should accompany the apparatus, and remittance should be by money order drawn to the order of "Bureau of Standards." If yours is a precision wavemeter which you want carefully calibrated at a number of points at the rate of 50 cents per point, make reference to Schedule (D) (a). The authority for the special reduced fee for amateur wavemeters is Paragraph (7) on page 2 of their Testing Schedule No. 90, and applications for work under this provision should make due reference to this paragraph in order to avoid confusion.

Some Dope on Hook-Ups

(Concluded from page 11)

Fig. 2 a circuit for the use of a detector and two stages of amplification with transformer repeating, operating off common A and B batteries, designed for potentiometer control of the plate voltage of the detector (which should not be an excessively-high vacuum tube), and providing for increased potential on the plates of the amplifiers (which should be high vacuum).

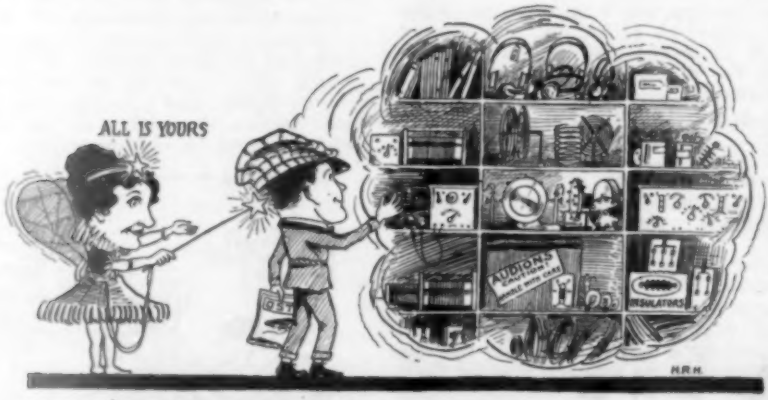
QST SUBSCRIPTION CONTEST

Here is what you have been waiting for. To many of the most enthusiastic amateurs, first-class apparatus is out of reach financially. With the idea of helping these amateurs, who may become leading relayers, QST offers a proposition whereby instruments of the very highest type may be earned by a little work at getting subscriptions. QST subscriptions may be had for the asking. Try it and see.

In our former contests we had definite prizes, announced beforehand, and while the prizes were all apparatus of unquestioned quality it had the bad feature that a contestant might win a rotary gap when he already owned one and would much rather have a hot wire ammeter listed as a prize lower down in the list. So in this contest we've thought of a better idea. We're not going to specify any definite apparatus, but instead the prizes are money values which we will invest for you in any apparatus you may choose from the catalogs of any of the manufacturers listed. For instance:

The contestant who sends in the largest number of subscriptions before February 10, 1920 wins the First Prize of $50.00 worth of apparatus. We will purchase for him any apparatus he may desire, up to a total of $50.00 catalog value, from any of the manufacturers listed. Or, if he desires some special piece of equipment listed in excess of $50.00, we will purchase that for him if he will send us a remittance to cover the difference.

For the one who sends in the second highest number of subscriptions, we will purchase $30.00 worth of apparatus, whatever he



WHAT YOU'VE DREAMED FOR: YOUR PICK OF THE BEST AMATEUR APPARATUS IN AMERICA

may select, from the catalogs of any of these manufacturers, or allow credit for that amount in the purchase of more expensive apparatus.

The third, fourth, and so on up to the twentieth, receive the amounts listed below. Look it over.

The conditions are not complicated. They are simply:—

1. Send in your name and address and we will send you some subscription blanks. To be entered in the contest, your subscriptions must be sent in on these blanks. Be sure to write your OWN name on the back of each blank so that we may know whom to give credit.

2. To be entitled to any of the first ten prizes, you must send in a minimum of 15 yearly subscriptions or their equal. To be entitled to any of the last ten prizes, you must send in a minimum of 10 yearly subscriptions or their equal.

3. Any one is eligible, whether a subscriber or not.

4. Twelve credits are given for each yearly subscription. Short term subscriptions are counted in proportion. Extentions of existing subscriptions and renewals count the same as new subscriptions. Special discount coupons not accepted in this contest.

5. All subscriptions must be in this office before midnight February 10, 1920. If received later, they will not be credited.

Scores will be printed monthly in QST so that you will know how you stand compared with the other entries. We will be pleased to tell you your score at any time by mail, send you more blanks, or help you in any manner possible.

DON'T MISS LINING UP EVERYBODY AT THE CLUB

Remember that you're actually doing folks a favor when you induce them to subscribe to our QST. QST is 100 per-cent amateur radio, and is the only genuine monthly joy-bringer "of, by, and for the amateur." Subscriptions will sell like hot-cakes. All you have to do to sell a "bug" is to shake a QST in his face and show him where to sign. Another thing which will help you is that there actually exist a lot of former readers whom we haven't been able to tell the good news that QST has reappeared, and the least intimation of your purpose should bring forth their little old one-fifty, pronto. But don't content yourself with the amateurs in your own town alone. Write all the fellows you know, for it's subscriptions that count for you. Don't forget that the most unexpected folks are often good prospects, just itching to hitch up with a good amateur magazine—which means us. Your best girl's brother's second cousin may be interested, and you don't want to miss any bets. Everybody starts out with an equal chance, but the hardest workers will be the winners. Are you on?

THE MOST UNEXPECTED FOLKS ARE PROSPECTS JUST F'RINSTANCE THE FAMILY DOCTOR

BEST AMATEUR APPARATUS IN AMERICA --- FREE !

MAKE IT BE YOUR NAME THAT THE EDITOR PUTS ON THIS ORDER

Here are the prizes. Prices for good apparatus naturally are higher than before the war, and now is your chance to have what you need handed to you free. Just scan this list and think what it will buy for you. Regenerative sets, amplifiers, headsets, variometers, condensers, detectors, V. T's., storage batteries, loose-couplers, transformers, rotary gaps, meters, switches—just exactly whatever it is that you most need to equip your station.

THE PRIZES

1st	Prize,	$50.00	worth	of	apparatus,	catalog	prices.
2nd	"	30.00	"	"	"	"	"
3rd	"	25.00	"	"	"	"	"
4th	"	22.00	"	"	"	"	"
5th	"	18.00	"	"	"	"	"
6th	"	15.00	"	"	"	"	"
7th	"	12.00	"	"	"	"	"
8th	"	10.00	"	"	"	"	"
9th	"	8.00	"	"	"	"	"
10th	"	7.00	"	"	"	"	"
11th	"	6.00	"	"	"	"	"
12th	"	6.00	"	"	"	"	"
13th	"	6.00	"	"	"	"	"
14th	"	6.00	"	"	"	"	"
15th	"	5.00	"	"	"	"	"
16th	"	4.00	"	"	"	"	"
17th	"	3.00	"	"	"	"	"
18th	"	3.00	"	"	"	"	"
19th	"	3.00	"	"	"	"	"
20th	"	3.00	"	"	"	"	"

And here is the list of manufacturers from whose catalogs you may select your prizes, choosing exactly what you wish from any number of firms. All you have to do is to send us a list of what you want, giving the manufacturers' catalog numbers, and will have the apparatus shipped you direct. You can't go wrong on any of this equipment. The firms are the best in the art and their products are recognized as a standard. If you haven't their catalogs, write for them. These manufacturers make

OODLES OF CATALOGS FROM WHICH TO CHOOSE

The Best Amateur Apparatus In America

Acme Apparatus Co.,	Cambridge, Mass.
Arnold, J. F.,	New York City
American Radio & Research Corpn.,	New York City
Barr Mercury-Cup Detector,	Washington, D. C.
Brandes, Inc., C.,	New York City
Bunnell & Co., J. H.	New York City
Burgess Battery Co.,	Chicago
Chicago Radio Laboratory,	Chicago
Clapp-Eastham Co.,	Cambridge, Mass.
Connecticut Tel. & Elec. Co.,	Meriden, Conn.
DeForest Radio Tel. & Tel. Co.,	New York City
Firth & Co., Inc., John,	New York City
General Radio Co.,	Cambridge, Mass.
Grebe & Co., A. H.,	Richmond Hill, L. I.
Marconi Wireless Tel. Co.,	New York City
Murdock Co., Wm. J.,	Chelsea, Mass.
North American Aerial Spar Mfg. Co.,	Dubuque, Iowa.
Radio Distributing Co.,	Brooklyn, N. Y.
Radio Equipment Co.,	Philadelphia
Thordarson Elec. Mfg. Co.,	Chicago
Tresco,	Davenport, Iowa
Tuska Co., The C. D.,	Hartford, Conn.
Universal Radio Mfg. Co.,	Elmira, N. Y.
Watkins Manufacturing Co.,	Wichita, Kansas
Wireless Improvement Co.,	New York City
Wireless Specialty Apparatus Co.,	Boston

AND MORE NAMES TO FOLLOW NEXT MONTH

Address all communications to

THE CONTEST MANAGER American Radio Relay League
Hartford, Conn.

The Operating Department

J. O. Smith, Traffic Manager
Rockville Centre, L. I.

AMATEUR radio has once more assumed its proper place in the activities of the day. It is a rather sad commentary on the state of things as they are, however when the League finds it necessary to pry off the lid by means of legislative action. The same powers-that-be that refused to allow amateur transmitting now, until forced to do so by Congress, are the same powers-that-be that welcomed the amateurs with open arms in the spring of 1917.

However, the fact that the lid has been lifted, that the might of one could not prevail against the right of many, makes every one of us feel glad that this is America and that we are Americans. Let us hope that the unwholesome spectre of autocracy has been banished forever from amateur radio, and that we may in future be assured of security against interference with our right to practice an art that hurts no man, but lastingly benefits many. Although the Country is dry, I have managed to fill a glass, and I now drink to the past, present and future of amateur radio—may it radiate and oscillate for ever and ever, without end.

The reports from the Division Managers this month are rather light. Possibly the sudden shock of the reopening was too much for them. However, it will probably be a question in a month or so as to what to do with all they have to say about the reopening of stations, forming of trunk lines, traffic, etc.

The attention of every member of the League is called to the fact that all amateur station licenses have expired and that new ones must be procured from the Radio Inspector. This was fully outlined in the Operating Department report in the September issue of QST.

The reports of the Division Managers follow:

ATLANTIC DIVISION.

Chas. A. Service, Jr., Manager.

At last the great day has come when once again we can watch the ammeter needle run across the scale, hear the old familiar radio voices calling us, blink lights to our hearts content and do all the rest of those things so closely connected with the operation of a transmitting set. And this time, like the removal of the receiving ban, the news came but a short time previous to the order going into effect.

But where are all those stations who were supposed to be up and ready on their toes to start relay work and general amateur chewing again? This report, written after the first night of reopening, is based on the fact that the Division Manager and his new partner, 2AGJ, listened on the air till a ripe old hour last night and only heard five local amateurs and no long distance at all. Did anyone hear 3QZ? When this report is printed in QST no doubt the air will be filled with all sorts of sounds, as in the old days, but just at this time, when some of the old guard are straining their ears to hear something on 200 meters further away than ten miles, it is distinctly disappointing to hear such silence.

Reports of District Superintendents were sent in before they knew of the removal of amateur restrictions on transmitting and therefore still contain much of the same hopeful tone and tentative placing of relay stations and new lines, but that time is past and we are now face to face with the necessity of GETTING GOING just as fast as we know how. The time is at hand when the hazy relay lines which are founded largely on hope and faith will be put to the test; the official stations which have already been appointed to handle the work must be on the jump to prove they can deliver the goods, otherwise the Assistant Division Managers and Superintendents will get busy rearranging lines and finding new stations which can handle the work.

The months of October and November will, perhaps, be the most important for the official stations and relay work in general, as it will be during these months that definite relay routes will be established, both inter and intradivisional, and those stations which get to work right at the start, show pep and efficiency and willingness, will be those which stand out in the mind of the District Superintendents when they go over the list of stations which have shown they can handle Trunk Line relay work, in order to appoint them permanently. Therefore, this advice to those who have not already taken it; get in touch with your Superintendent, work all the time to make your set produce results, let other relay stations hear you're on the job to handle their business, and it will soon become known that you are promising material.

We are sorry to learn that our old calls won't be reassigned but there's a very good reason back of it and in view of the fact that it will probably take us only a few weeks to get on to the new ones, there's no use in lamenting.

The great work of the League, as shown by the fruit of their labor in Washington to bring action on the transmitting ban, can not be overestimated by amateurs today, who can be pretty certain that but for the efforts of the League, they would still be silent in etheral circles. The value of concentrated action, of affiliation into one big League, of numbers to back up arguments, of a united front representing men and boys from every part of the United States, is demonstrated beyond a doubt in the results of the American Radio Relay League. The most potent argument to any man who doesn't know whether he will join the league or not, is to remind him of the fact that if many thought as he did, there would be no amateur transmitting today and perhaps not tomorrow or the next day. Think it over and you'll be proud of the organization to which you belong.

Next month's report will have definite relay routes as shown by reports from Assistant Division Managers and District Superintendents, which in turn will be based on actual results of relay stations. So get on deck, make yourself known to your Superintendent and you'll be one of those elected for a trunk line or branch route.

ATLANTIC DIVISION
(Northern Section).

Guy R. Entwistle, Ass't Division Manager, 136 Sutherland Road, Brookline, Mass.

Relay stations will be located at the following points in New Hampshire: Concord, Pennacook, Franklin, Tilton, Laconia, Ashland, Plymouth, and Warren. All good stations and can be depended on to handle relay work. There will be about 25 others, smaller but promising material, for feeders and distributors. Formation of a radio club is being undertaken. All radio enthusiasts in New Hampshire and especially around Laconia should get in touch with Dist. Supt. Henry R. McLean, 342 Union Ave.

We wish that more radio amateurs would get the spirit and join the great radio fraternity of relayers. No initiation fees, no expenses whatever, but excellent returns.

Local amateurs will be glad to know that 1LE, Harvard Wireless Club, will be back strong this Fall. Mr. Sumner B. Young writes that the old set, a quenched-gap 500 cycle ½ k.w., will be used.

The Technology Radio Club is again active after many weeks of vacation. Mr. Hamilton Maxim, son of the president of the A.R.R.L., is a member. Messrs. Henry Kurth and Fullerton Webster, local amateurs are actively associated.

A trip to Portland resulted in lining up a few live wires in that district. Mr. Earl G. Ham will look after things for us up there. They had a large radio club before the war. We hope they will soon get together again . Mr. Cassinau, who was stationed at Bar Harbor, should make an excellent leader.

Mr. Donald F. Alexander, of 209 Elm St., Bangor, has been appointed District Superintendent of Northern Maine.

District Superintendents Bates, of Worcester; Pulley, of Greater Boston; Hardy, Northern Mass.; and Bowen, Lower Mass. and Rhode Island, all report progress in their respective territories.

Wm. G. Walker, formerly 1ATR of Everett, was in from Vancouver, B. C., the other day. He reports much amateur activity in the Northwest. He is going to submit a Canadian Relay Chain to us, including several of the Canadian colleges that have high-powered sets. The Canadian Government seems to be taking advantage of the lesson learned by costly war-time experience and is encouraging amateur activities. The Canadian amateurs, it will be remembered, have a sliding scale of wave length instead of power as they approach commercial government stations. Fifty meters is all that is allowable within ten miles. It is remembered that the St. Lawrence is ice-bound in the winter months and commercial activity ceases, leaving the ether free for the amateurs, who can use most any power or wave length. This compensates for the smaller number of stations and should permit good co-operation between our chains and their's.

ATLANTIC DIVISION.
(Southern Section)

Chas H. Stewart, Ass't Division Manager, St. David's, Penna.

In view of the fact that the prohibition against amateur transmitting is lifted, there is no doubt that within a short time, after the necessary formalities of obtaining licenses from the Department of Commerce are completed, there will be great activity. Our experience so far has been that there is only one real way to build up a successful relay system, and that is through the beginning of actual radio communication, supplemented by activity on the part of all the officers of the League. Until the present time it has been up-hill work to get many interested. It is now believed there will be a rapid change in the situation.

Mr W. T. Gravely, Supt. for the Central Virginia District, has been giving very ac-

tive consideration to the question of establishing the route to the South (Line D), and his efforts are greatly appreciated. He states that his station is in readiness to operate just as soon as he receives his licenses. He is hoping to have a good short range route between Danville, Va. and Washington, D. C., and he should receive the assistance of all stations in that territory to enable him to accomplish this as soon as possible.

No reports were received this month from Mr. Schaeffer, of Washington, D. C. or from Mr. Duvall, of Baltimore, and it is assumed that the absence of these reports was due to the fact that, no change having taken place in the situation, there was little if anything of interest to report. However, they will not have that excuse next month, and it is hoped that they will then be able to report much progress.

The Superintendent of the Eastern Pennsylvania District, Mr. E. R. McCaskey, reports that he is obtaining considerable information regarding prospective stations, in outlying districts. He is especially anxious to get into communication by letter with some good relay station in or near Lancaster, Pa. He has also located some prospective stations in Wilmington, Del., as this seems to be a very desirable link in Line D. (Bangor, Me. to Jacksonville, Fla). Until the appointment later on of a District Superintendent for the State of Delaware, Mr. McCaskey is temporally endeavoring to cover the territory in connection with his own District.

As stated in last month's report, the Central Pennsylvania District is temporarily in charge of Mr. Herbert M. Walleze, 234 Vine St., Milton, Pa., during the absence of Mr. Cawley, the Superintendent. He has communicated with State College, and feels sure they can be relied upon for satisfactory relay work. He seems to be optimistic as to the future after the ban on transmitting has been lifted. He is particularly anxious to get into communication by letter with good relay stations in Harrisburg or vicinity.

The main routes for the successful operation of a portion of which this section of the Atlantic District is responsible are as follows:

LINE "B"

Philadelphia to San Francisco, Cal. via Pittsburg, Pa, Columbus, O., Indianapolis, Ind., St. Louis, Mo., Kansas City, Mo., Denver, Col., and Salt Lake, Utah (Central Route).

LINE "D"

Bangor, Me. to Jacksonville, Fla. (Atlantic Route).

The following tentative routes have been mapped out through this territory. The success of these routes is dependent upon securing reliable stations at the points named, and they are in no sense to be considered as a final arrangement.

LINE "B" (Northern Penna. Route).

Beginning at Philadelphia, Pa. thence via Bala, Pa., St. David's Pa., Norristown, Pa., Pottstown, Pa., Reading, Pa., Pottsville, Pa., Sunbury, Pa., Milton, Pa., State College, Pa., Curwensville, Pa., Punxsutawney, Pa., Butler, Pa., Pittsburg, Pa., Beaver Falls, Pa., thence connecting with Ohio points via Columbus, Ohio.

LINE "B" (Southern Penna. & Md.Route).

From Philadelphia, Pa., Bala, Pa., St. David's, Pa., to Lancaster direct (or via the Northern Penna. Route to Lancaster) thence via Marietta, Pa., Harrisburg, Pa., York, Pa., Hanover, Pa.. Gettysburg, Pa., Hagerstown, Md., Cumberland, Md., Uniontown, Pa , Monongahela, Pa., Washington, Pa., or Pittsburg, Pa., thence connecting with Ohio points via Columbus, Ohio.

LINE "D"

From Trenton, N. J. via Bristol, Pa., Philadelphia, Pa., Chester, Pa., Wilmington, Del., Elkton, Md., Belair, Md., Baltimore, Md., Washington, D. C., Alexandria, Va., Fredericksburg, Va., Richmond, Va., Lynchburg, Va., Danville, Va., thence connecting with the East Gulf Division.

LINE "D" (Alternate route Philadelphia to Baltimore).

From Philadelphia, Pa. via Line "B" (Southern Penna. Route) to Hagerstown, Md. thence to Frederick, Md. and Baltimore, Md.

BRANCH LINE No. 1.

Philadelphia, Pa., Bala, Pa. or St. David's, Pa., Norristown, Pa., Emaus, Pa., Allentown, Pa., Leighton, Pa. or Bethlehem, Pa., Wilkes Barre, Pa., Scranton, Pa., Susquehanna, Pa. or Sayre, Pa., thence to Central New York points.

BRANCH LINE No.2.

Pittsburg, Pa. to Erie, Pa. via Pittsburg, Pa., Butler, Pa., Grove City, Pa., Meadville, Pa., Cambridge Springs, Pa., Edinboro, Pa., Sterrittania, Pa., Erie, Pa., thence to New York points connecting with Line "A" (New York to Seattle, Wash.)

The above lines are based upon a survey of locations of stations prior to the war, and it is hoped that the owners of any stations who feel they can assist in bettering these routes will promptly communicate with me, giving the locations of stations with whom they believe they can communicate.

I would also like to hear directly from the owners of stations at any of the points above mentioned, with an expression of opinion as to whether they can be depended upon for relay work, or not. In this way only can the proposed routes be put upon a working basis. Any stations that will prove of value will be added to the routes

as soon as they are known to me. The Assistant Division Manager hopes that he will have the hearty support of everyone in his District in endeavoring to arrange for the routes.

ROCKY MOUNTAIN DIVISION.

M. S. Andelin, Manager.
120 Canyon Road, Salt Lake City, Utah.

Mr. Ira Kaar, 243 7th South St., Salt Lake City, has been appointed Assistant to the Division Manager.

No other appointments have been made, altho we need another Superintendent in Colorado and some good men in Idaho, Montana and Wyoming, practically no response having been made by amateurs in those states. You fellows who want to get in on the relay stuff must get busy now. If you don't you will probably get left, because we intend to have all appointments for official stations made quickly.

We have a condition in this Division probably unlike those in any other division. The amateur population is very scarce. Long jumps in relaying will be necessary. Most of the transcontinental relay traffic will probably have to go via Trunk Line B and to insure proper communication at all times we will have a number of standby stations thruout the central part of this division from the north to the south, so the station having the best conditions may take the work. According to my observations the conditions vary considerably and they will all be kept busy. Static and fading signals are two common troubles here.

I want to organize branch lines in Montana, Idaho and Wyoming, but unless we hear from new members we will have to leave the arrangements until we resume transmitting and are able to find stations that can do the work.

Mr. Beedle, of Reno, Nev., reports he will be with us soon. This station will fill in the gap between Salt Lake City and the Coast. Mr. Kaar reports a new station being erected in Bountiful, Utah.

WEST GULF DIVISION,

F. M. Corlett, Manager,
1101 East Eighth Street, Dallas, Texas.

Since the last monthly report of this division only one appointment has been made. Mr. Bennett Emerson, 3730 Wendelkin Street, Dallas, Texas, has been appointed District Superintendent of Northern Texas. All communications pertaining to Northern Texas District should be addressed to him. Mr. Emerson will begin the organization of an efficient traffic force for his district immediately and all amateurs are urged to communicate with him at once so that he can best determine the men suitable for Asst. Dist. Supts. and also make selections of stations for trunk lines.

The District Superintendent of Southern Texas and the Division Manager have been counting on Beaumont, Texas, to fill a gap between Houston, Texas and the Eastern boundary of the West Gulf Division where it joins the East Gulf Division but so far it seems that our efforts have been in vain. It is hoped that Beaumont will yet come forward with a good station capable of filling this gap, which is also a gap in Line "C" Jacksonville, Fla., to Los Angeles, Calif. It may be necessary to locate this route further North, possibly connecting with the East Gulf Division via the Northern Texas District.

The Division Manager is still desirous of hearing from men located in Oklahoma and Arizona Districts who would be willing to act as District Superintendents of those Districts.

James L. Autry, Jr., Dist. Supt. Southern Texas Dist., 5 Courtlandt Pl., Houston, reports plans under way for a Club in every city in his district except Beaumont, which place seems utterly lacking as to radio.

On Sept. 18th a meeting was called of all the radio men in the City of Houston and a club was started with an initial membership of thirty. The Club is known as The Houston Radio Club and will within the next month make application for affiliation with The American Radio Relay League. There are under construction in the City over ten stations which hope to do long distance relay work for the A.R.R.L.

Mr. W. H. Tilley, Asst. Dist. Supt. of Austin. Texas Territory reports that the club there is progressing nicely and is making immediate application for affiliation. There are over four high powered stations under construction in Austin. The Lone Star Capitol can depend upon radio connection.

PACIFIC DIVISION.

Seefred Brothers, Managers,
343 So. Fremont Ave., Los Angeles, Calif.

The list of relay men who are expected to be on duty when the ban is lifted, are given below:

F. G. Beck
L. A. Bartholomew
L. Dillon
J. F. Hopkinson
C. H. Keller
A. A. Kluge
H. St. J. McIntosh
Seefred Bros.
C. W. Tilden
F. Van Why

PACIFIC DIVISION,

F. Terman, Ass't Div. Manager,
Northern California.

The following is the list of tentative relay stations for the district of Northern California which are expected to assist in relay work:

San Francisco	6SH
Oakland	6AC
Alameda	6AHN
Stanford and Palo Alto	6AG, 6FK, 6FT
San Jose	6AU
Monterey	6GC
Walnut Grove	6KU
Lodi	JS
Sacramento	6RA, 6PN

This list covers almost all of the possibilities among the old relay men, as these are the only ones heard from who are planning to start up out of the former long distance stations. With a few exceptions the new relay stations, excluding those above mentioned, must come from the ranks of the new amateurs.

In order to facilitate the accurate and quick transmission of messages, I would suggest that the manager send out instructions to be distributed among the relay stations as to the proper preamble for all messages, how to count the words of a message, as numbers, initials, cable count, etc. (This will be fully covered in the next issue—Traffic Manager.)

L. E. O'Brien, 902 South G St., Apt. 34, Tacoma, Wash, District Supt. for Washington, sends out an SOS to complete Trunk Line A and build up Line F thru Washington. All amateurs considering relay work are urgently requested to communicate with him as soon as possible with a view to appointments. This invitation is extended to radio amateurs in British Columbia.

Harmonics

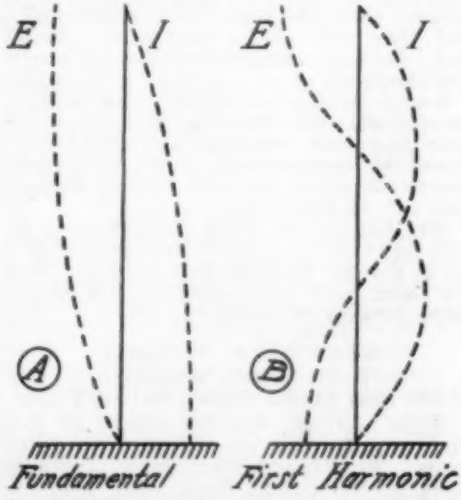
THE Editor has received a number of letters from readers inquiring for information of various kinds about harmonics, and the correspondence shows so many erroneous conceptions that it seems advisable to present a little information on the subject.

Eccles defines harmonics as follows: "In the natural oscillation of a circuit possessing distributed capacity and inductance, the harmonics are those component vibrations whose frequencies are integral multiples of the frequency of the fundamental. A harmonic is called even or odd, according to whether the multiplier is even or odd . . . In electrical affairs the harmonic of double the frequency of the fundamental is. . . . called the second harmonic, and so on."

The next feature of interest is a well-known fact in the study of wave forms in electrical engineering: that if a complex wave is such that successive positive values of the ordinates for a positive half-wave are numerically equal to the successive negative values for the succeeding negative half-wave, only the odd harmonics occur. Such a wave is called symmetrical and therefore contain only the odd harmonics.

This will be better understood by reference to the figures. "A" represents the voltage and current distribution along a vertical wire antenna oscillating at its fundamental frequency, and it will be seen that the length of wire is equal to the distance from node to loop, or ¼ of the wavelength. Such an antenna may oscillate with other current and voltage distributions, but the top must always be a node for current and the bottom a node for voltage. Thus in "B" is shown the next possible oscillation. Here the length of wire is ¾ of a wavelength and hence the period is one-third of the fundamental, which is to say that the frequency is three times as great. Other possible oscillations have frequencies five, seven, nine, etc. times the fundamental.

Terminology differs with various experimenters, some preferring to call the first harmonic one-third of the fundamental, the second harmonic one-fifth of the fundamental, etc., but in general in radio we may call the fundamental the first harmonic and say that a frequency three times



the fundamental is "the third harmonic", and so on.

Have you ever accidently picked up an arc set when tuning at a wavelength under 600 meters? If so it was on a harmonic, and it is in this connection that a knowledge of harmonics is particularly interesting. The energy content of the overtones generally is quite small by comparison with the fundamental but interesting experimental

work may be done by tuning for the harmonics. Radiation from a high-frequency alternator generally does not contain many harmonics, but the arc stations are rich with them and arcs within a few hundred miles usually can be copied without the necessity of tuning up to their fundamental. If you know their wavelength, get the bulb oscillating and carefully search for them around the most convenient harmonic and generally success will reward your efforts. (It may here be said, in the nature of a caution, that for transocean work and the reception of optimum signals, stations should be carefully tuned in at the fundamental, and in letters received from readers complaining of weak arc signals we notice that frequently the constants of the circuits employed are such as to make reception of the fundamental impossible and obviously the reception has been on a harmonic.)

From the foregoing data it may be seen that the first tune on which we could get such signals is one-third of the fundamental, and so on. Certain stations can be copied on tunes that do not seem in accord with this theory, possibly due to strong re-radiation from guy-wires at some mixed multiple, and government engineers are now making a study of the subject.

Experimental work is also being done in the direction of transmitting on harmonics, using an antenna circuit wavelength three or five times that of the closed circuit and obtaining creditable radiation on the overtones—a feature which may have considerable interest for us on account of the desirability of having a long aerial for receiving purposes. This is possible only with arc transmitters, spark transmitters being comparatively free from harmonics. The same line of experimentation bids fair to overcome the difficulties of short wave transmission with arcs. It is well known that much difficulty attends attempts to produce stable oscillations with an arc at wavelengths much below 1000 meters, but successful sets are now being made wherein the antenna circuit is tuned to a harmonic of the closed circuit, with very fair over-all efficiency.

It is rather fortunate from the standpoint of our relay work that these features are confined almost entirely to arcs, or spark QRM would be multiplied as many times as there are harmonics.

Notes on the Quenched Gap for Amateur Use

By H. J. Tyzzer

Engineering Dept., American Radio and Research Corpn.

NUMEROUS articles have been published on the development of radio during the war and it has been pointed out that perhaps no other art has taken such rapid strides toward perfection. A large part of the work was devoted to the study and improvement of vacuum tubes for both transmitting and receiving. As a result, tube amplifiers have been constructed which have increased the range of the receiving station many times. The tube transmitters, although very effective for local work, are limited in output and hence cannot be used to any great advantage for long distance transmission.

For this reason the Navy Department has deemed it advisable to adhere to the conventional 500 cycle quenched gap transmitters. Such an equipment has proven both effective and reliable and large quantities of standardized sets of this type have been manufactured during the war.

It would then seem advisable for the amateur who wishes to transmit long distances and still adhere to government restrictions to follow as closely as possible the path laid out by the Navy Department and experienced commercial companies. It is planned that this paper shall point out a method whereby this desirable objective may be attained.

It is assumed that the amateur has at his disposal a source of 60 cycle alternating current. With such a supply it is customary to employ a step-up transformer, a high potential condenser, some form of gap, and an oscillation transformer, together with such accessories as a key, protective devices, and radiation ammeter. However the power of the above equipment is limited because of the 200 meter wave restriction. With such a low wavelength it is practically impossible to employ a condenser of more than .01 or .012 Mfd. capacity and have allowance for inductance of leads and proper coupling. This means that a much higher voltage must be employed by the amateur than if a supply of higher frequency were available. Such a high voltage often leads to gap difficulties, condenser troubles and low efficiency. It used to be customary to employ a plain gap which ordinarily gave a note that was anything but pleasing on

60 cycles and which was noisy in operation. This gap also caused a wave having a very high decrement to be emitted from the transmitting antenna, which tuned broadly at the receiving station and caused a great deal of interference.

The introduction of the non-synchronous rotary gap into the amateur field marked a great improvement in transmitters in general inasmuch as a clear note with appreciably decreased decrement in the antenna circuit was obtained. Even with a rotary gap, however, the conditions are far from ideal as the efficiency is usually quite low and the decrement often exceeds the 0.2 allowed by government regulations. Or in other words, when the coupling is made sufficiently loose to bring the decrement below 0.2 the equipment is not operating with maximum radiation.

For this reason it has seemed advisable to investigate thoroughly the results obtained by using a quenched gap on a 60 cycle supply. These investigations were carried on in the laboratories of the American Radio and Research Corporation at Medford Hillside, Massachusetts, and the following data recorded which shows the advantages of the quenched gap.

Tests were first made with a ¼ K. W. Blitzen transformer. This type transformer is resonated to a capacity of .01 Mfd. on 60 cycles. It was found impossible to work this transformer at its rated capacity with the leakage tongue which is inserted between the primary and secondary in place. Therefore the tongue was removed and resonance sacrificed for increased output. Three mica condensers of .004 Mfd. each were used totalling a .012 Mfd. capacity. The plain gap consisted of two centimeter brass balls, whereas the rotary was of the Murdock type, the quenched gap being manufactured for amateur use by the American Radio and Research Corporation.

A Murdock oscillation transformer was used with a phantom antenna consisting of a .00035 Mfd. capacity, a loading spiral and 10 ohms inserted resistance. The quenched gap was compared with both the rotary and plain gap referred to above and the following data obtained:

TEST NO. 1.

Total antenna resistance—15 ohms.

Gap	Input Watts	Wave-length	Watts in antenna	Efficiency
Plain	135	200	41	30.4%
Rotary	135	200	43.6	32.4%
Quenched	135	200	60	44.5%

TEST NO. 2.

Gap	Input Watts	Wave-length	Watts in antenna	Efficiency
Plain	250	200	73	29.2%
Rotary	250	200	82.5	33%
Quenched	250	200	94	37.5%

A ½ K. W. Blitzen transformer was then tried and 10 more ohms inserted in the antenna circuit thus totalling approximately 25 ohms and the readings below obtained:

TEST NO. 3

Gap	Input Watts	Wave-length	Watts in antenna	Efficiency
Plain	500	200	170	34%
Rotary	500	200	190	38%
Quenched	500	200	225	45%

From these readings it may be seen that a considerable increase in output was obtained (by the use of the quenched gap) and hence better overall efficiency. It was found possible, by selecting the proper number of individual gaps for a given power in the quenched gap unit, and by adjusting a variable reactance in the primary of the transformer, to obtain an exceedingly clear note of double frequency (120 cycles). This means a double discharge per alternation of the 60 cycle wave and gives a pleasing tone resembling that of a rotary gap running at low speed.

The transmitter was then connected to an L type antenna consisting of two wires 60 feet long and approximately 55 feet high. With 200 watts input the maximum antenna current obtainable with the rotary gap was 1.6 amperes. With this setting the decrement as determined with a Kolster decremeter was approximately 0.6. The coupling on the Murdock oscillation transformer was reduced until the primary and secondary coils were nearly at right angles. In this position the antenna current had dropped to 1.1 amperes and the decrement decreased to 0.2 (the maximum value permitted by government restrictions). It was found, however, that this 1.1 amperes at 0.2 decrement was far more effective than 1.6 amperes at 0.6 decrement. This was determined by observing the deflection of the wattmeter in the decremeter circuit, in both cases leaving the coupling conditions between the antenna and decremeter the same. We have all heard that the reading of an ammeter in the antenna circuit is an untrue indication of effectiveness with a plain or rotary gap and this is absolute proof of that fact.

The rotary was then replaced by the quenched gap and, with the same power input (200 watts), a radiation of 2.1 amperes was obtained. The decrement was only 0.12 which is well within the limit set by the government. Now then, note the comparison under these practical working conditions. With a 200 watt input 1.1 amperes radiation with the rotary and 2.1 amperes with the quenched gap, and, as the energy in the antenna is proportional to the square of the current this means a ratio of 1.21 to 4.41 or, in other

(Concluded on page 35)

WHO'S WHO IN AMATEUR WIRELESS

We shall publish each month two pictures of amateurs who have become known to us in our work. This will draw us all closer together. We are often curious as to just what the other fellow looks like, and here's our chance to see.—Editor

R. H. G. MATHEWS.

Born at a very tender age on January 16, 1897 (Shhh!—by subtracting 1897 from 1919 we get 22.)

Got bit by the radio bug in 1908 while living in Springfield, Ohio. Moved to Chi in 1910 and inflicted an electrolytic interrupter and a 2" coil on the natives until 1912 under the alias of "RM" (Morse in those days).

Acquired the "long distance" habit in 1913 ("long distance" in those days meant 60 miles). In 1915 became notorious as 9IK and later achieved the distinction of 425 meters and blossomed forth as 9ZN and worked both coasts on 1 K.W., incidentally acting as Central Division Manager for the A.R.R.L. and taking an Electrical Engineering course on the side, and operating for the Marconi Company in the summers.

Smelled the war coming and enlisted in the Navy as Radio Gunner two weeks before the declaration. Tried to enroll

F. H. SCHNELL.

In resuming "Who's Who" we are pleased to present to our readers Mr. Fred H. Schnell, of Chicago. He is a well-known figure around Chicago amateur meetings but all of us are not so fortunate as to have met him.

His interest in radio dates from 1908 when he started to make an inch spark-coil but, deciding it was too small, started making a transformer, which suffered the same fate; then a 1 k.w. open core, but found even this didn't have enough power to increase his range much even when the window was open, so he discarded it and made a 2 k.w. This was back in 1911, in the days of unlimited power and wavelength, and the Chicago Wireless Association had him listed as a long distance amateur with a range of 20 miles. The law of 1912 scared him into getting a decent set, and the three-slide tuner and silicon went with the old transmitter.

In May, 1917, he enrolled in the Naval

R. H. G. MATHEWS.

everybody in the Navy with circular letters for a while and then served variously as Radio Censor at Grand Haven, Mich., and Benton Harbor, Mich., on the U.S.S. Yantic (often and correctly spelled "Antique"), in charge of the Great Lakes Radio Laboratory where Lieutenant Comdr. A. Hoyt Taylor conducted his famous experiments on underground antennae, as Officer in Charge of radio investigations in the 9th, 10th, and 11th Naval Districts Intelligence Dept., and finally as District Radio Material Inspector in the same districts, continuing at this to date.

Was recently pleasantly surprised at being elected Vice-President of the League and also appointed Central Division Manager.

Figuring on making more noise than ever before with a brand new transmitter, and in having lots of fun in using underground aerials, eliminators, static preventers in profusion, probably to the everlasting ruination of all receiving results.

Favorite pursuits—arguing with M. B. West, 8AEZ, on rotary gaps, and preaching vociferously against the use of VT's as detectors, supplanting the old gas tubes.

F. H. SCHNELL.

Reserve as 3d class Electrician, Radio, and was successively promoted to 2d, 1st, and finally Chief, serving at Great Lakes, Belmar, and Washington Transatlantic Radio Control Office, and made three trips with the Presidential Party on the U.S.S. George Washington. His service is typical of the aid which successful amateurs were able to give the Navy, wholly as a result of amateur experience. While in uniform several incidents befell him which any radio man would cherish: While at Belmar he copied the first message from Rome (IDO) to President Wilson; copied the armistice acceptance message from Nauen (POZ) while at Washington; and his was the honor of transmitting to POZ the first message sent since our entrance into the war.

He is an ardent A.R.R.L. booster, and a regular whirlwind at organization, as his results in the Chicago District testify. One of our Vice President and Central Division Manager's right-hand men, he has most creditably acted as Chicago City Manager of the A.R.R.L. since our reorganization, but outgrew that job and is now Eastern section Assistant for Mr. Mathews—which ought to hold him for a while.

U-Boat Radio

By J. A. Crowdus

HOW would some of you radio bugs like to find yourselves suddenly turned loose and free to do as you pleased in the radio shack of one of the late Kaiser's latest and largest sea-going U-boats? You'd have a heluva time wouldn't you? Well, that is exactly what happened to yours truly, for for three weeks I was solely in charge of such a radio shack and carried the key to same securely tucked away in my hip pocket. Here's how it happened. After the German subs had surrendered, a bunch of American submarine men attached to the flotilla then lying at Portland, England, were sent up to Harwich to man four of the U-boats. I was then, and had been for the past year, attached to one of the U. S. subs operating in European waters. When I was informed that I was one of those being sent to Harwich I was—well, like the small boy receiving his first wireless signal, just a bit excited. But to get down to the main part of my story—we reached Harwich in due time, and immediately went aboard and took over our four allotted boats. Of course the first thing I looked for on my boat was the radio shack, and after having missed it on the first trip thru the boat I found it on the second, securely tucked away in one corner of the central compartment. Take it from me I lost no time in getting acquainted with the mysteries of the various pieces of apparatus. Of course all the directions, name plates etc. were in German, which, while helping to complicate matters somewhat made the work of exploration all the more interesting. And believe me I did SOME exploring. A lieutenant commander, erstwhile radio expert, walked in as I was looking over the station and gave me to understand that I was not to "monkey with any of the apparatus", and by no means take any of the instruments apart. I gave him the customary "Aye, Aye, Sir," and then proceeded as soon as he had departed to dis-assemble and disintegrate every piece of apparatus in the shack. I despaired of ever getting 'em all together again, for I apparently had enough parts for a couple extra sets. However it was finally done, but not until I had gained some interesting information.

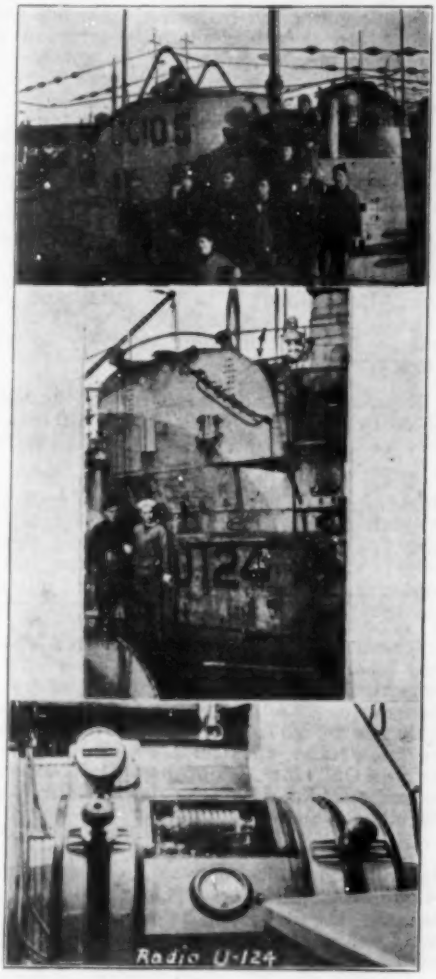
In the first place their spark receiver was a crime. Honest, fellows, no good amateur would have such a set in his station. The material and workmanship was unexcelled. The hook-up looks like a Chinese puzzle. I have sent the circuit diagram to the Editor for a look, so I can

prove it by him that it would require a couple of college educations to decipher it. (Okeh—Ed.) Their trouble seems to be that they attempt to tune too finely. They have a thousand and one taps, intermediate and stand-bi circuits, variable condensers with only two plates, etc., the result being that the inside of the set looks like the back of a telephone exchange. At any rate with the crystal detectors provided I couldn't make the darn thing bring in signals near as loud as they should.

Besides the spark receiver they had an audion outfit that was a combined undamped receiver and transmitter; a two stage amplifier; and a two K.W. quenched gap transmitter that was a bird. Believe me, their transmitters were as good as their receivers were bad. The accompanying photo of this transmitter shows its general construction. The quenched gap can be seen in the center while below it is the hot wire ammeter. The tuning is all done by variometers, the adjustment controls of which can be seen at the right and left sides of the set. The scales are calibrated directly in wavelengths and down at the bottom of the set are switches, each point of which corresponds to a different scale. The transformer, gap motor blower, and condensers are inside the set. The latter are built along the lines of the Murdock molded condenser. A frequency meter is shown at the top of the picture, while above it outside the view is a peculiar switch arrangement for starting the motor generator.

The motor generators—there were two of them—were not in the radio room at all. I looked for this part of the transmitting set for quite a while before I finally found it. I threw several switches and a hand starter that were obviously for the motor generator, and then opened the door of the radio shack and listened. Yes, there it was—stuck way back in the corner of the next compartment. I don't savvy yet their reason for having it in such a place. A switch outside the radio room marked "Umformer 1" and "Umformer 2" attracted my attention, and upon inquiring from someone who knew a little German I found that this ment motor-generator 1 and motor-generator 2. From that I inferred that there must be two motor generators. It then followed that I should throw this switch and utilize the afore mentioned listening procedure, which I did. I traveled nearly thru the boat before I found the second machine located 'way back in the electric control compartment. Of course the reason for having the two so widely separated was to insure radio communication even though one compartment became flooded.

The transmitters were designed for 425 meters, the U-boats working wave, and on that tune the HWA shot up to the maximum scale reading, 16 amps when we were using the obstruction cables for an aerial. And speaking of aerials, quite a bit was written during the war about the U-boat's radio. They were supposed to have aerials raised aloft by balloons, tall masts, etc., etc. Well, I can say right here that that was all bunk. The U-boats had two aerials, both very simple and ordinary. These were the obstruction cable, and the regular aerial. The obstruction cable was a pair of heavy phospher bronze cables running from the extreme bow up over the conning tower



bridge to the extreme stern. These were provided so that any obstruction such as nets, etc., encountered under water would pass along the top of these cables up and over the boat and prevent its becoming

(Concluded on page 39)

"STRAYS"

Don't seem at all good to be operating again, does it? Oh, no!

Fellows, it must be awful to be located so you can't run a set when you want to. We had a letter from poor old Kern, otherwise "Pinky", sometime 9GY, now a very busy student at Ann Arbor. Along comes re-opening and the little bug is biting him again. He says he's mightily tempted to chuck the whole game and go get a job driving a grocer wagon so he can have a chance to operate.

Deal, of 9NN in better days, is in the same boat, only at M. I. T. Who's going to take the place of these stations, down the Mississippi Valley?

Now to bust up that Thordarson contest!

Speaking of contests, we've one all our own. Read about it in this QST, and get right. Remember about the early bird, and be the first in your territory to get started.

Need any books? Don't forget the QST Book Department. A stack of literature here waiting for you fellows to write for it.

A tip to spark-coil operators: With a step-down transformer, of the type used for operating toys, lighting Christmas trees, etc., you can operate your coil very nicely on 110V. A.C., using the vibrator interrupter the same as with D. C., and eliminate the expense and nuisance of batteries.

Every once in a while we get a check for $3.50 to cover A.R.R.L. dues and a subscription to QST. Of course we apply the extra $1.50 for an additional subscription to QST, but everyone don't seem to know that the annual A.R.R.L. dues include QST for 12 months. Do your part to make this clear to the new ones in your vicinity.

We have a brilliant clerk. Every day he grows in radio knowledge. (Association, m'boy, association!) The other day we casually asked him if he understood what was meant by a "three-element vacuum tube." He said he had been reading about one such tube, "the only one the amateur can use", and that as he understood it the three elements in this case were Marconi, Moorhead, and deForest! Howzat?

Errata: Refer to pages 4 and 5 of August QST and make following corrections. In Fig. 7, add shunt variable across secondary for tuning purposes. In the detector tube (center) in Fig. 4, the B battery is short-circuited by a dead wire. Insert by-passing condenser in this lead, the same as for preceeding two tubes.

Wanted: Some more interesting war-stories of radio men, like the article by Mr. Crowdus in this issue.

Anybody working CW sets on 200 meters? We'd be glad to have a description of any that are proving successful. We're afraid we're going to have lots of trouble with 200-meter undamped. The frequency is so high that an extremely precise adjustment of the heterodyne frequency must be made at the receiver.

The only power tube available for us seems to be the so-called Marconi tube, made by Moorhead and licensed by deForest for the use of three electrodes. The Marconi Co. have enjoined deForest from the manufacture of the Oscillion, on the grounds that it violates the Fleming patents. It takes rather a stretch of the imagination to see how this can be.

The Marconi V.T. will make us a pretty good tube, tho. A set using one Moorhead type RH tube was hurriedly constructed at the Washington Navy Yard for use on the U. S. S. George Washington on the occasion of the President's first trip overseas, and with 750 volts on the plate this set was heard (telegraph) at Otter Cliffs when the George Washington was 1200 miles out. An interesting case, too, of "high-powered receiving vs. high-powered transmitting."

On Saturday mornings during the fall and winter months the Massachusetts Radio & Telegraph School is conducting a free course in radio for amateurs at their school in Boston.

The Post Office Department is going to erect short-wave stations at its various landing fields for use with the mail-planes. We understand the installations will be G.E. tube sets—C.W.

The demand for Wouff Hongs is decidedly on the up-grade. Also the desire to break into the shacks of certain little boys and carefully rewire the transmitters by leading every wire to the binding-post marked G.

Our British cousins are not yet operating. As a correspondent puts it, "We

have got a lot of washer-women in Parliament here who wear nothing but red tape." Perhaps the example of our own Navy Department will help.

You enterprising westerners: why not arrange a free service for tourists, reporting daily on the condition of the roads in various localities, detours, etc., and keep the information posted on a hotel bulletin-board? It would be gratefully received, and help to show some folks that amateur radio isn't a child's toy.

Another old-timer threatens to erect a record-breaking ham set. Mr. J. K. Hewitt, formerly of Albany where he acquired nation-wide fame as the operator of old 2AGJ, is now located in Philadelphia, and jointly with our Atlantic Division Manager, Mr. Chas. A. Service, Jr., aspires to build the best long-distance station that Philadelphia ever saw.

Tell us about your new apparatus, experiments with circuits, kinks, etc., so we can publish them and let everybody get the benefit. It is that co-operative spirit that makes our QST the best amateur mag. in the world. Its all ours—just think! And all of us help to make it what it is. The dope in it is real, because we are not printing articles written by chaps who just naturally have to write something on radio—anything so it's something—to get the price of a new winter hat.

A great many amateur condensers made from photographic plates employ two sheets of glass in each dielectric, to withstand the voltage. Mr. Elra E. House, of Battle Creek, Mich., introduces an innovation in such construction by shellacing narrow vertical strips of cardboard between the two glasses in such a manner that the oil, in which the condenser is immersed, may circulate by thermo action thru the very heart of each dielectric, keeping it thoroly cool. He uses four half-inch strips of cardboard between each set of glass plates. The strips on all the plates should line up when assembling, so as to take care of the stresses.

The oil in which transformers and condensers are immersed should be thoroly "dry." A very small percent of moisture greatly decreases the insulating qualities. The moisture may be removed by filtering the oil thru several layers of heavy blotting paper. A slow job, but it's worth it.

Every radio club ought to have a good wave-meter; in fact, the acquisition of a precision wave-meter has been the reason for the start of many a radio club. It is worth its weight in VT's in tuning the stations of the members.

QST Chicago Amateurs.

A new radio organization has recently been formed in Chicago under the name of the Ravenswood Radio Association. It is believed to be the first of its kind, as all its members are the possessors of commercial licenses. It is, however, purely an amateur club and the restriction of having all members commercial licensed men was made merely with the intention of raising the standard of the amateurs. All those connected with the club are members of the A.R.R.L., the club's affilation with the A.R.R.L. has been applied for, and practically all members are possessors of modern stations ready for relay work. It is a good live bunch of experienced amateurs. Membership is still open to applicants who can qualify, and every amateur is cordially invited to visit the meetings, which are held weekly every Tuesday evening at the club headquarters, 1917 Warner Avenue. Mr. N. E. Wunderlich is the Secretary, and he will be pleased to hear from those interested in this organization.

One of the most progressive amateur organizations of the country is the Radio Engineering Society of Pittsburg, of which Mr. Burton P. Williams is President, and Mr. C. E. Urban the Secretary. The club has grown rapidly, and recently opened its permanent quarters at 408 Second Avenue, Pittsburg, with a house-warming to which all local amateurs were invited. The club has an excellent station, an almost ideal receiving aerial, and a library is now being installed in its large and commodious quarters—all of which make a live radio club a thing of joy to its members. The Secretary edits a most interesting department in the Pittsburg Gazette-Times every Sunday under the heading "The Radio Amateur", and has done very commendable work therein in assisting in the removal of the amateur restrictions in co-operation with the A.R.R.L.

You juniors going up against your first Radio Inspector: take a tip. In the name of the Great Rettysnitch don't make the fatal error of snowing your transmitter hook-up with a spark gap in the antenna circuit, or out the window you will go. It's posilutely against the law. Read up—see "The Junior Operator" in this QST.

Wot ho? Is it really possible that nobody except the ol' A.R.R.L. claims credit for getting off the amateur lid?

THE JUNIOR OPERATOR

A great many requests come to us to run a page for the benefit of the less advanced experimenter to whom many features which the older relay birds regard as known by everyone may not be known at all. So with the hope of being of assistance to the younger fraternity we will endeavor each month to present items of help in this page. If there is some feature of general interest which you would like to have explained herein, the Editor will appreciate a line from you.

AERIALS.

"How long can my antenna be for 200 meters?" is a frequent question. It depends on the aerial—and its location. For work on amateur tunes, and for both sending and receiving, a four-wire flat-top "inverted L" aerial is as good as any. It is almost impossible to forecast the natural period of an aerial, as its capacity depends so much on the nature of the structure between it and the ground and on the presence of nearby metal objects, trees, etc. Absolutely the only satisfactory way is to erect it and then measure its period with a wavemeter. For operation on 200 meters its natural period should be around 170 or 180 meters, the difference to be made up in the inductance of the oscillation transformer or helix in the station. In general we can say that a four-wire inverted L flat-top, wires spaced 3 feet apart, will have about the right values when the total length of flat-top, vertical portion, lead-in, and ground lead (to point of actual contact with the soil) is 110 to 115 feet.

HOOKING UP TRANSMITTERS

The sending set must be arranged to have two tuned circuits, with the spark gap in the primary or closed circuit. Once upon a time the circuit shown in Fig. 1 was used a great deal by beginners in the art, under the mistaken supposition that it provided the utmost range for their set. Since 1912 it has been prohibited throughout the globe by International Convention because it causes great interference and a small spark-coil set using this hookup can completely put a kibosh on everything within its range. It radiated a "broad wave", which is to say that it has no particular tune at a receiving station but instead may be heard as well at one adjustment as at another, so that there is no method of tuning it out to receive other signals. This effect is caused mainly by having the resistance of the spark-gap in the antenna circuit, and to remedy it the gap, with a condenser, is put in a separate circuit and coupled to the antenna circuit magnetically, as shown in Fig. 2. This shows an oscillation transformer, but that is not imperative, as the same result can be secured with a straight helix if it is provided with three clips as arranged in Fig. 3. Note that in this diagram the turns comprising the closed circuit are entirely distinct from those in the aerial circuit; in other words, no turns are common to both circuits, and it is by regulating the number of turns in common that coupling is controlled in such a circuit. Three clips are essential, for otherwise the coupling would be so close that a broad wave would still be sent out and the set would not comply with the law.

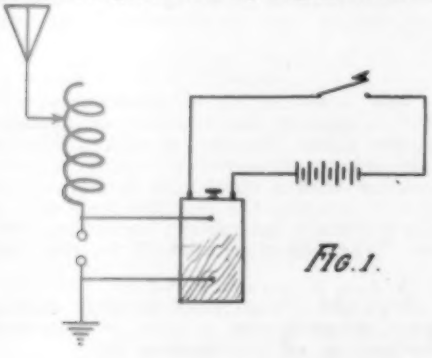


FIG. 1.

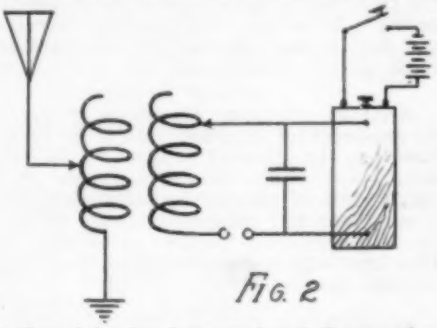


FIG. 2

Right here we'd like to call attention to certain knock-down spark-coil sets which are being shown in department stores for the holiday season. These sets use the helix only as a loader, as in Fig. 1, and show the gap in the antenna circuit. You absolutely can not get a license for such a set, and it is illegal to operate it unless the circuit is changed as in Fig. 2 or Fig. 3 so as to get the spark-gap out of the radiating circuit.

A fixed gap is the only one that can be used with a spark-coil. Many amateurs know that a rotary is unsatisfactory with a coil but not all know why. We will try to explain it as follows: In a transformer set operating on alternating current, the high-tension current flows evenly back and forth in each direction just the same as the input current did, so that the condenser is charged during every alternation, and so a rotary gap works all right. In a coil, however, the current does not alternate. Instead it is merely interrupted by a vibrator, and vibrators are constructed in almost all cases to give a high-speed "break" and a slower "make". The result is that a coil has a very high-tension secondary current at "break" but practically none at "make". In other words, a spark-coil is idle about half the time, and if a rotary gap were used under these conditions its lugs would come together at times when there was no charge in the condenser.

The best gap for a coil set is a stationary gap with a fine screw adjustment,

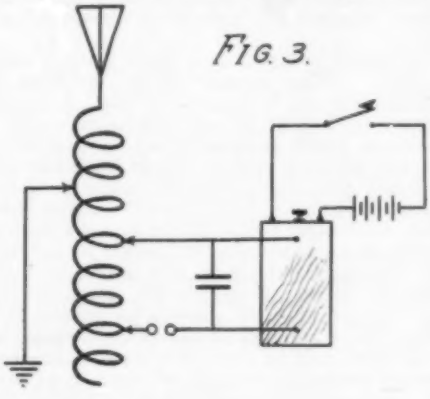


FIG. 3.

equipped with cooling flanges to prevent the electrodes from heating, and mounted on a base of good insulating material

LEARNING THE CODE

The best way to do this is to have a partner. It requires lots of hard work and time, and only by conscientious application can one become a good operator. The Editor believes the easiest way to be to first memorize the code thoroughly, so that that you can say to yourself "Q is two dashes, dot, and a dash", and so that you will immediately remember that three dots is S, etc. This is the easiest part, however, as even after this is done you won't be able to tell a dot from a dash when you hear it. A practice buzzer set is the next thing. Practice the alphabet until every letter is familiar, alternating with your partner. Then try spelling out simple words the same way. Don't try to progress too fast, and it is important to never attempt to send faster than you can receive. When you can recognize words you are ready to attempt simple conversation back and forth, and it is surprising how quickly a speed of six or eight words a minute will be attained. Then you have all the rudiments, and it is simply a case of sticking with it diligently, and you will find that every week your receiving speed goes up a few notches. In practicing, avoid writing down the characters forming a letter. Learn to think quickly and train yourself to identify that combination of characters instantly. If you miss a letter, in most cases the sense of the matter will show you what it was.

Your sending speed will take care of itself, as if you can read you can send. But of all things don't attempt to send "fancy". There's not a thing to it. Dots are dots, and dashes are dashes; make them so if you expect the other fellow to "get you".

Notes on the Quenched Gap

(Concluded from page 28)

words, that the quenched gap is over three and one-half times as effective as the rotary.

With the rotary gap considerable difficulty was experienced with kick-backs which punctured the insulation on the transformer and blew fuses, etc. With the quenched gap, however, none of this trouble was noticeable. In operation the quenched gap was almost noiseless, which is an obvious advantage when it is considered that a great deal of amateur long distance transmission is accomplished in the early hours of the morning, much to the discomfiture of the household and neighbors. With a rotary gap very high potentials are built up in the antenna circuit, which tend to strain and even rupture the insulation. With a quenched gap this is not true, as the sparks follow each other regularly and are of uniform potential.

Briefly, then, we may sum up the advantages of the quenched gap over its nearest competitor, the rotary gap, as follows:

1. Increased efficiency of transmitter.
2. Practically noiseless in operation.
3. Less potential in antenna system.
4. Decrease in decrement of emitted wave.
5. A clear note without the use of moving parts.
6. Less trouble due to kick-backs, etc.

With such an outfit the standard of the amateur will be nearly on a par with the commercial companies operating today, and it is to be expected that with a transmitter of this type and an efficient receiver, far greater distances will be spanned by the amateur than in pre-war times.

Radio Communications by the Amateurs

The Publishers of QST assume no responsibility for the statements made herein by correspondents.

QST BROOKLYN AMATEURS
—An Invitation—

Editor, QST,
Hartford, Conn.

The prevalence of inefficient operating was responsible for the organization of the Radio Traffic Association of Brooklyn, N. Y., in January 1917. It is again preparing to carry out its main objects which are to minimize unnecessary interference and reduce inefficient operating by the dissemination of practical ideas. It also purposes to promote good fellowship and establish an efficient relay system among the amateurs of Brooklyn.

At present the officers are, Ferd. C. W. Thiede, Chairman, Albert R. Heydon, Secretary; Ernest K. Seyd, Financial Secretary; and Clifford J. Goette, Treasurer.

All amateurs of Brooklyn, above the age of eighteen, desirous of connecting with an organization offering obvious advantages, are cordially invited to communicate with the Chairman at 486 Decatur Street, Brooklyn, N. Y.

Very truly yours,
Radio Traffic Association.
A. R. Heydon, Secretary.

ANYBODY HELP HIM?

Dear Editor:

It seems as though the monthly visits of "QST" out in this part of the country are the only things to keep a fellow interested in amateur radio. For a week or so after getting my copy things look fine and prospects for a good "season" are fine but after the first week or so and after listening to the general line of stuff that is in the air I lose faith and begin to believe that we never will again hear the old familiar 9s and 8s and GVs and RDSs, etc. I have often wished that QST was issued weekly but that is a little bit too much to ask.

A peculiar condition exists in this town of near ten thousand people. I am the only one in the whole city that is more than ordinarily interested in wireless. To get assistance in erecting masts is like pulling hens teeth. It can't be done. If I want to put up anything higher than 40 feet (and I have passed the stage of being satisfied with 40 feet) it is necssary to hire somebody to assist me at a rate per hour that would make the average ship builder green with envy. BUT every cloud has a silver lining. When we get back on the brass, local interference will be nil. No interference in a town of this size is another condition that I'll bet obtains in no other place in the country But for my part I'd rather have the interference and help and brotherly interest in the game than this trying to keep up one's enthusiasm by listening to NAA, NAR, NAJ, NAT, NAW, etc., etc., almost without end. What I want is to hear "HOW IS MY SPARK", "HOW IS MY TONE". That stuff don't amount to anything of course but at the same time it is the stuff that amateur wireless is built on, for we all started that way. This wail that I am unloading on you won't help things in the least but I have got to tell it to some one and maybe some of the other readers can get some sympathy out of it.

Another thing that I have on my chest is this. When orders came out that we could listen in I hooked up what I had on hand consisting of an Audiotron and a medium sized loose coupler with a slider on the primary and a couple variables etc. For the first week I heard nothing. Absolutely nothing. I tried every conceivable way to induce some of those nice musical wireless signals to come down and rest a minute in my phones, but nothing doing. Finally after considerable cussing and spitting on the cat (apologies to the "Old Man") I remembered that I once read that a magnet held at certain angles to the bulb would increase intensity of signals. I tried it. Since then I have heard stations that before the war were far beyond my reach. Such stations as KKO (Southern Pacific Steamship "Excelsior") roll in as pretty as you please. It takes extremely close adjustment of the magnet but it sure gives results. There probably is something the matter with my circuit although I am using the standard Audio-Tron hook-up. If anyone can throw any light on this subject it certainly will be greatly appreciated for it is very unhandy to be pushing and lifting a large magnet around on the operating table.

Well, I thank you for reading this line that I sling and hope with you and five thousand others that before long we can be listening to the heart-interest stuff that was in the air before the war.

Sincerely,
G. R. Hammond, Asst. Dist. Supt., A.R.R.L.
219 Fifth Ave. South,
Oelwein, Ia.

MORE ABOUT V. T's.

New York, September 17, 1919.
Editor, QST.,
Hartford, Conn.
Dear Sir:—

I have read Mr. Hassel's article on the VT's in the September number with a great deal of interest, and concur with him in general throughout. I would like however, to bring to your attention the fact that this company is at present putting on the market for amateur use through the Marconi Company, as their distributing agents, a type of tube having the standard VT characteristics, but with a detector sensitiveness equal to or better than that of the old type de Forest gaseous tubes.

This tube is the result of development work done jointly by this company, the Marconi Company and the Moorhead Company, and it is designed especially for amateur use, to fulfill the rigid specifications that they insist upon. While being a sensitive detector, and as good an oscillator as the old tubular type de Forest gaseous tube, it has the distinct advantage of the standard four prong base, and a filament life two to three times greater. These tubes may be obtained directly from the Marconi Company. They have the disadvantage that the B battery adjustment is critical, and they therefore require a variable B battery, as was the case with the old style audions. They are not designed to be used as amplifiers, as the standard de Forest VT audion or the Marconi VT is highly exhausted for this purpose.

I also wish to notify the amateurs through your columns that the infringing manufacturers of the old type de Forest gaseous audions will soon be enjoined, so that this type of tube will be no longer available.

Very truly yours,
(Signed) Robt. F. Gowen.
For De Forest Radio Tel .& Tel. Co.

OUR CHEST IS OUT.

Mr. Gilbert E. Maul, of Chatham, N. J., writes us an encouraging letter, in part as follows:

"Dear Eddy:

Say boy, if U keep on putting QST out like U did the Sept. nr., everybody in the good old USA will go rdo crazy. Gee, when my copy came it was so thick I thot U were doubling the advertising section, but when I saw that it was chuck full of all good things like loops, VT transmission, CW receivers, amateur situation, etc., I said to myself 'that K. B. W. certainly is busy this month all right!' Not to mention Here & There. Good stuff .Don't worry about short articles once in a while. Short and snappy—that's us! Spark coil panel set—good dope. More CW stuff and loop aerial articles, too

Well, regards to A.R.R.L. and QST. Excuse bum writing but am on a train and QRM is fierce at 50 m.p.h."

OUR LIFE'S NOT ALL ROSES.

222 Cherry St.,
Dunmore, Pa., Sept. 24, 1919.

Dear Editor:

I have been trying the Crowdus hookup out as described on page 7 of the Sept. QST and I don't think much of this alleged "hook-up". In the first place it is a fussy old hookup that is nothing more than the deForest hookup or ultraudion of 1907, plus the Armstrong feed-back coil, and we all gave that up before the war. I wish you would tell me why they need the two circuits or wires to the plate. I had a letter from our mutual friend S. Kruse in Washington, and he gave me a hookup that is the best that I ever used. Several of the boys use it here and will swear by it as the easiest hookup to handle. Will you tell me why it is not advocated in QST? Why in the devil do you try to make the boys think they are getting something new, when it is the same old cigar with another label on it? And last of all, I notice that you use a condenser on the tickler on page4, August QST. We cannot make any use of this condenser on any tickler. And we find, as you say, the deForest anti-static circuit spoils the whole set.

H. E. Blackburn.

(We took this awfully to heart, and we've tried to clear up some of these points in this issue. Mr. Blackburn's hook-up—the one he likes—is the old reliable tickler with straight audion —Ed.)

'NOTHER "TRADE-LAST"

902 Second St.,
Beaver, Penna.

Dear Editor:

I don't know exactly when my sub. expires but I'm not going to be caught napping and lose a number of our lil ol' QST. Therefore enclosed is a money order for $1.50 for which you will please continue my subscription.

And "dear Eddy" (apologies to 9HS), may I tell you what I think of QST? It's the BEST (not one of the best)—the best radio magazine going, and I've seen 'em all. I'm beginning to think there is someone up there whose brains are "geared" exactly the same as mine. Honest, I sit here reading one of your articles and try to dope it out and pretty soon some question forms itself in my mind. I read on and sooner or later every one of those questions are answered just as I wished them to be. Strange but true.

Several times, some of the blooming young hams down this way come to me and ask me what I think about—well, the new V T's. I tell them that I don't know much about them except what QST says about them and go on to tell them. I always end my "sermon" by telling them that if QST said the moon was made of green cheese, I would believe it. As soon as possible I'll touch 'em up for a subscription, huh? (Yes, Bo. —Ed)

Well, you've had enough of this, so best wishes to QST and the A.R.R.L.

Yours, etc.,
Geo. R. Boardman, Jr. (Ex-8AH)

CLEANING BRASS PARTS.

Mr. Charles Stanley Gridley, of Chicago, had an idea one day and it worked, and so he writes the Editor:

"I wanted to remove the tarnish, oil, dirt, etc. from some brass parts, such as clips, contact points, switch levers, etc., and decided to try this stunt. Make a strong solution of hot water and "Gold Dust" and put on the stove and boil. Empty the things to be cleansed into the solution and boil for a few minutes. Remove and thoroly wash in water, then dry and polish with a soft cloth. The scheme works great, and now that amateurs are renovating old material, especially brass, it may be a good practical suggestion "

MORE ROSES.

Pneumatic Stamp Co.
Binghamton, N. Y.

Dear Sirs:

I received my QST O.K. and I want to say this, I get so Goll Darned Oscillated over that paper, that I never think of eating my supper

I start to read it, and I want to make all the things in it. I feel like buying all the instruments advertised. I get a new ambition, therefore I rip off my connections on my set and hook it up a different way. Oh, I have an awful time when I receive QST That's the best radio Mag. in the world.

Chas. Reynolds.

SCOOP!

The Radio Club of Mansfield.
Mansfield Ohio, October 3rd, 1919.

The A.R.R L. Inc.,
Hartford, Conn.,
Gentlemen:—

The good news received today along with QST. I certainly was surprised myself, but the other hams who hadn't received their issue of QST yet couldn't believe it at all, so I trotted around town with your pink notice "BAN OFF" as if it were the Declaration of Independence or something.

Several months ago I got the gang together and we all decided that we were off of this back yard radio stuff for good, so we all chipped in enough for a couple thousand dollars, bought a site, poles, four step amplifier, 1 k.w. quenched and 5000 square feet sheet metal for a ground system.

Station wont be completed for a couple of months yet, but when she is you can count on us to see that the trunk lines swerve thru Mansfield. As soon as we can we also intend to install a Radio Telephone and C. W. apparatus.

Am getting all the new birds lined up for subscriptions both to QST and A.R.R.L. Hoping that we may soon hear you pounding the brass again down in Hartford and that the Old Man's Woof Hong is still well preserved on your shelf for antiquities, I am

Sincerely yours,
C. C. Endly, President.

WANNA JOB?

Dear Editor:—

Enclosed please find $1.50 for year's subscription to QST, and also announce that I will be "shootin' the breeze" sometime in the near future; that is, if there are a couple fellows want my job and 3AEP's with it. Have done some amateur work in Philadelphia up to 1915 when I entered the commercial game, but on account of being married will have to knock off and show these amateurs in North Carolina what amateur work is.

You no doubt remember 3AEP, J. F. Rau, from Philadelphia. Anyway, he will be out at the same time I go, and between us two we will be there strong and hope that QRM has been QRT by then.

By the way, send me your Wouff Hong for about three minutes so I can start clean up week when I open up, as the younger generation has already bought the automobile man out of Ford spark-coils and with the direction finder we will be able to use the W. H. to fine advantage.

Well O. M. I will QRT for this time, and look for the next issue of QST.

Yours for the better days,
C. A. Roethlinger,
U.S.S. Seminole, Wilmington, N.C.

P.S. If you happen to know any men who want a job on this cutter, let me know. 1 Chief Elect. and two 2nd-cl. Elect—ship for one year.

MAKING WIRELESS APPARATUS.

To the Editor of QST:

One night when I was waiting for the sun to get low enough for me to ascend to the attic, where I have my little set, without being half baked, I picked up a Radio magazine. From start to finish it

was nothing but how to make apparatus. I thought then of when I was a little ham just starting how I looked with great awe upon such articles and after I had read them over I would go to bed and dream of Micro Henries and the rest of the Mikes and get up groggy the next morning.

Making your own apparatus is great and I take my hat off to the fellow who makes his set and has it working O.K. any time day or night, but how about the little fellow who hardly knows what size wire to use, buys a lot of stuff he can never use and then, after he works for over a week finds out that what he has made wont work? Take my advice, fellow amateurs who are just beginning; buy your first set from some reliable company and then, after you have had some experience handling radio apparatus make a set of your own design.

Another thing that I have noticed among beginners is that they do not know how to buy. They usually send to some concern who offers great bargains (on paper) and then when they receive the goods find that it is of no value. Also, amateurs, buy an audion set. Why bother around with mineral when for a little more money you can purchase a real set? Most of the bugs eventually buy one and then find that they have a galena detector and some bum fixed condensers that they can't use. Why waste time and money? Make your set right in the first place and afterwards think of experimenting with mineral and making apparatus.

"Bugs".

3RO HEARD FROM.

W. T. Gravely, sometime 3RO, writes us as follows from Danville, Va:

"All quiet down this way, insofar as radio is concerned, and I am looking for practically the same conditions to exist in future as existed before we entered the war, that is, a small number of stations. My outfit will likely be the only one in the city, not counting the little fellow with his spark-coil, for he is ever present.

Since April 15th I have erected a single strand, which runs in no particular direction, and have heard most of the arcs in this country: NSS, NFF, NWW, NDD, NAW, NAT, NAU, NAA, NAO, NPL, NBA, and others. Have also heard several of the foreign stations but have never been able to catch them signing and while I think I know who they are, they are not claimed until I am certain and have heard them sign a time or two.

The fact is I have had so very little time to listen that I cannot hope to check up all I hear. Yet it is splendid to be able to open shop once more and don a pair of phones when one has the time and the inclination. My transmitting apparatus is still boxed but can be gotten out and tuned up in an hour or two after the word has come to go ahead. I'd like to have the old call 3RO again, but don't think Baltimore anticipates bothering about such matters."

U-BOAT RADIO

(Concluded from page 31)

entangled or injured. By simply placing insulators at the ends of these cables and attaching a lead-in, they made a very good aerial. The regular aerial, however did show an improvement over those found on the subs of the allies. The Germans had two steel masts, one fore and one aft, that folded over by a system of gears at their base into a recess in the deck. They were raised from inside the boat by electricity or compressed air. Two phosphor-bronze wires stretched tightly between them made up the antenna. These masts were about 35 ft in height. The aerial wires were always stretched tightly between the masts whether they were erected or lowered, for the masts were moved absolutely together and the tightness of the wires thereby maintained. On "our" boat one of these masts was cracked at the base so we were unable to raise it and had to use the obstruction cable aerial entirely.

The combined audion receiver and transmitter mentioned above was more or less of a mystery. No one was able to get one of them working at the time and I am somewhat inclined to believe that they had been "fixed" so they wouldn't work. They were certainly acmes of construction. In fact, all the German apparatus was made to stay made. The two stage amplifier I got working after some trouble. The results were disappointing, however, for it didn't amplify like a real two-stage should. The German vacuum tubes were inferior to ours; in fact they were declared by some who claimed to be experts to be five years behind our own. One pecularity about the German sets was the absence of binding posts. Not one was in sight, the plug-in system being used entirely. The transmitting key—well, it was certainly a crime. It weighed about 4 lbs. and the lever about 3 lbs. It was characteristically German, for it would take a big overgrown Dutchman to manipulate it. Anyone wishing to take a look at said key call around at my shack—for there it will be found on exhibition.

Transmitter Efficiency

By M. B. West

IN wireless, as in other arts, sometimes things are taken for granted which would on second thought bear investigation. The modern 500 cycle commercial transmitter has been developed, I believe, solely on the statement that the telephone receiver responds with considerably louder signals to a high frequency than a lower one. Every amateur knows that with a limited power input a very much lower spark frequency than 1000 per second gives the greatest range. It is easily understood that with a given power input there will be just three and one third times as much energy in each impulse in a set that gives 300 sparks per second as in one that gives 1000 sparks per second, altho if each were equally efficient the hot wire ammeter reading would be the same, since the hot wire ammeter reading represents the average current value. I do not believe that any one would be so rash as to make the statement that a telephone receiver is 3⅓ times as sensitive to WEAK signals at 500 cycles as it is at 150 cycles. It is unfortunate for the amateur that the quenched gap was introduced commercially before the rotary gap was developed to its highest efficiency.

In working with high frequency currents it is soon noted that the difficulties and losses encountered are very much greater as the wave length decreases. On the other hand energy is radiated very much better at the lower wave lengths. By careful attention to design and construction many of the difficulties can be overcome and losses partially prevented at least, in a manner that should for the purposes of the amateur produce results that are not ordinarily attained in commercial work. The design of the gap used is by far the most important factor tho by no means the only one. The ideal gap is one that possesses infinite resistance till the moment of discharge, zero resistance during discharge and infinite resistance after the useful energy is transferred to the open circuit. In explanation, suppose a condenser is charged to 20,000 volts potential and suddenly connected to a circuit having no inductance and a resistance of 1 ohm. It is evident that a current of 20,000 amperes will flow in that circuit for a length of time, depending on the size of the condenser, and almost instantly this current will decrease to zero. Just think what a "kick" such a current would give your antenna. Of course a primary circuit permitting such a condition is impossible, but let us enumerate the things that make it impossible. First the factor of resistance. We can reduce this to a very low factor by making the condenser itself of material possessing good conductivity. The loss in the dielectric is in effect resistance and we can substitute oil for the usual glass and thereby decrease this loss 80 per cent. And of course as has been often repeated, we can construct the whole primary circuit so as to have low resistance. We hardly expect to reach 20,000 amperes in our closed circuit, but just go to some power plant and look at the size of the bus bars provided to carry a current of 1,500 amperes and then go home and look at your closed circuit and draw your own conclusions. Then the resistance of the gap itself. This depends on the clearance between the moving and stationary electrodes and on the number of square inches of surface provided for the current to jump from and toward. Ask your electric light man how big a carbon he would use in an arc lamp using 1,500 amperes and then go home and take another look at your gap.

Next comes the factor of inductance. Fortunately we don't need much of that, but let us make what we must have effective for the purpose for which it is needed and that is to transfer the energy to the open circuit. Consequently we can go so far as to make the leads from the condenser plates through the gap and back absolutely straight except for the turn in the oscillation transformer itself and of course the necessary "fan" as the leads to the individual condenser plates separate. It would be ideal to mount the rotary gap on a vertical shaft directly above the condenser and have the primary of the oscillation transformer consist of one vertical loop directly above that. Also, if one must have, for any reason, leads from the condenser of any appreciable length, run them close together, so that their inductance is neutralized as far as possible.

Now comes the problem of closing the circuit suddenly thru a gap that will have low resistance at the moment of closing. The difficulty is that as the electrodes approach each other the spark WILL JUMP TO MEET the approaching electrode thereby closing the circuit at a time when the gap has a high resistance. Brush discharge from the approaching electrodes is the chief difficulty encountered here. If you do not believe this, close your key with gap stationary and the electrodes just separated far enough so that the spark does not jump and examine the whole closed circuit in the dark.

This difficulty can at least be partially overcome in two ways. First, by so constructing the electrodes that either rounded or flat surfaces are presented as the electrodes approach each other and secondly, by increasing the number of gaps. The writer, in company with Mr. Clausing, formerly of 8YL, constructed and tested practically every form of gap ever described in print and we believe a number that have never been described. One type in particular illustrated the point of brush discharge very well indeed. This particular gap was similar to the much discussed saw tooth gap in that both the stationary and moving electrodes were of copper strip and set at a considerable angle to the radius of the disk. When this gap was revolved "forwards" so that the ends of the electrodes approached each other the spark would jump fully ½ inch to meet the approaching electrode but when it was revolved the opposite direction this was reduced to less than ⅛ inch. No other changes were made in the circuit. The number of gaps that may be effectively employed seems to be limited by the amount of inductance in the primary circuit and the clearance between the electrodes. The writer constructed a gap having twelve pairs of electrodes in two straight lines and found that for a wave of 208 meters 4 gaps in series with a clearance of .015 gave decidedly the greatest radiation while at 400 meters six gaps were decidedly preferable. As it was only possible to vary the number of gaps by twos, (as 2, 4, 6, 8, or 10 in the circuit) it is entirely probable that 3 or 5 gaps might have produced much better results as the difference between 2 gaps and 6 gaps was appreciable and the difference between either 2 gaps or 6 gaps and 4 gaps was very great indeed. However, the matter of the number of gaps is not nearly as important as the shape of the surfaces presented, altho the added efficiency gained by the use of four gaps is well worth the troubles involved in construction.

Next in order is the problem of stopping the discharge as soon as the effective energy is transferred to the open circuit. This problem of "quenching" is not so difficult as is commonly supposed, and this statement is borne out by the fact that almost any amateur set with a good ground and an antenna of fairly low resistance, if properly tuned to resonance, is well within the legal requirement as to decrement. Two methods of accomplishing this result are possible. First by making the sparking surfaces as large as possible. This, of necessity, consists in making the edges of the electrodes wide as they approach each other, as the possible speed of rotation does not permit the utilization of surfaces extending more than perhaps ⅛ inch in the direction of the circumference. Wide electrodes have also the desirable factor of decreasing the resistance, which is extremely desirable. The writer was engaged in experiments just previous to April 6, 1917, to determine the effect of the width of the electrodes, but for obvious reasons was unable to conclude them. However, gaps were constructed with electrodes varying in width from that of points to a width of 1½ inches and it was noted that as the width increased the length of the portion (measured circumferentially) which was discolored by the spark decreased. The width of the electrodes employed should be as great as the spark will fill and from such experiments as I have been able to make this width would seem to be at least 2½ inches. The second method is by increasing the speed of rotation in order to more quickly reduce the separation of the electrodes. This is not particularly effective unless the clearance of the electrodes is kept very small indeed. The writer succeeded in constructing a gap having an eight inch disk revolving 6,000 RPM with four stationary electrodes having a clearance of .015 inches that was satisfactory and ran for several months without any trouble whatever. It was noted in increasing the speed from 3,000 RPM to 6,000 RPM and reducing the number of moving electrodes from six to three, that while the spark jumped as far to meet the approaching electrode as at the slower speed and continued as far over the surface of the electrodes as before, yet this result was accomplished in just one half the time with a corresponding decrease in the number of oscillations. A further increase in speed should be possible and a still larger disk could no doubt be successfully used.

My conclusions are that the ideal gap for a 200 meter transmitter must have wide electrodes, have the approaching corners smoothly rounded or beveled, have at least ⅛ inch of flat surface with extremely small clearance, revolve at very high speed, consist of four gaps in series and have the current path thru it consist of one or two straight lines and not with as many as eight right angles as are seen in some gaps used. Every successful gap that I have seen or seen described has been developed along one or more of the principles outlined.

It is very easy to measure accurately the efficiency of the gap you are using. Get a piece of smoked glass and examine the spark while the gap is running. You can estimate quite accurately just how far the spark jumps to meet the electrode and just how far the disk moves before the spark is extinguished. Divide the RPM by 60 to secure the number of revolutions per second. Multiply the circumference

of the disk in inches (at point where electrodes are mounted) by the number of revolutions per second, this giving the number of inches per second that the electrode travels. Using the fraction of an inch that the electrode travels in the duration of the spark as a numerator, the distance per second that the electrode travels as a denominator and multiplying by 1,500,000, the number of cycles per second for 200 meters, you secure a very close estimate as to the number of oscillations occurring during the passing of the spark. It should be easily possible to reduce this number to at least 35 and while that is considerably more than the necessary 4 yet it is a very great deal less than 300 or 400 which is about the usual result with the ordinary rotary gap.

The overall efficiency and range of any transmitter will be found to vary almost directly with the number of oscillations per spark, the range and efficiency increasing as the number of oscillations decrease. Poor resonance between the closed and open circuits, a poor or small antenna, a poor or long ground or any other bad condition in either circuit will be reflected in the behavior of the gap. A number of amateur stations have made remarkable records which violated every principle herein advocated but in every instance they will be found to have had the advantage of extraordinarily high antennae or have used excessive power or wave length and we can rest assured that we will be held more closely to the requirements of the law in the future.

M. B. West.

QST's Directory of Calls

EACH issue until the appearance of the Department of Commerce's List of Radio Stations containing amateur calls, QST will publish all reported call-letters. You are urged to co-operate with us and help to make this as complete as possible. QST can perform no more important duty in these days of reorganization than to keep us all posted on this subject. Do your bit by telling us your call as soon as it is assigned you.

First District

Wallace E. Heckman	119 Windemere Road, Auburndale, Mass.	1AA
H. M. Lane	27 Linnehan St., Cambridge, Mass.	1AB
L. L. Perkins	460 Walnut St., Brookline, Mass.	1AC
Chas. S. Doe	13 Artwell St., Milton, Mass.	1AD
S. B. Young	294 Ashmont St., Dorchester, Mass.	1AE
Harvard Wireless Club	Harvard Union, Cambridge, Mass.	1AF
Walter R. Weeks	67 Pleasant St., Marlboro, Mass.	1AG
Alfred Hall	Main St., Norfolk, Mass.	1AH
Clayton A. Thompson	142 Glenwood St., Lynn, Mass.	1AI
H. Kurth	126 Columbia St., Cambridge, Mass.	1AJ
H. C. Bowen	168 Belmont St, Fall River, Mass.	1AK
G. R. Entwistle	137 Sutherland Road, Brookline, Mass.	1AL
Fullerton D. Webster	12 Hampshire St., Everett, Mass.	1AM
William C. Kohl	75 Richardson Road, Melrose Hglds., Mass.	1AO
R. W. Mathewson	872 River St., Hyde Park, Mass.	1AP
C. S. Gould	123 Hamilton Ave., Lynn, Mass.	1AQ
Benjamin B. Coleman	193 Clasp St., Milton, Mass.	1AS
Jacob Coolikoff	48 Cutler St., Winthrop, Mass.	1AT
C. D. Davis	8 Cedar St., Wakefield, Mass.	1AU
H. W. Randolph	419 Chatham St., Lynn, Mass.	1AV
Hiram Percy Maxim	276 Whitney St., Hartford, Conn.	1AW
J. A. Campbell	9 Fairles St., Somerville, Mass.	1AX
C. D. Tuska	136 Oakland Terrace, Hartford, Conn.	1AY
Geo. U. Readio	62 Yale St., Springfield, Mass.	1AZ
Arthur Ferguson	52 Linden St., Everett, Mass.	1BA
Stewart Perry	38 Pleasant St., Winthrop, Mass.	1BB
Ralph A. Reed	8 Cedar St., Wakefield, Mass.	1BC
C. J. Westman	347 Cambridge St., Cambridge, Mass.	1BD
Henry W. Wickes	83 Woodside Ave., Winthrop, Mass.	1BE

Ernest Wood	2 Baldwin Terrace, ——— ———	1BF
C. F. Shorey	249 Grove St., Melrose, Mass.	1BG
Wilbur H. Hardy	776 Hale St., Beverly Farms, Mass.	1BH
Geo. D. Darling	30 Swains Pond Road, Melrose, Mass.	1BI
E. S. Herrick	5 Gladstone St., Greenwood, Mass.	1BJ
D. F. Alexander	209 Elm St., Bangor, Maine	1BK
Homer E. Nichols	513 Pequonnock St., Bridgeport, Conn.	1BM
Russell Noyes	62 Austin St, Newtonville, Mass.	1BN
Clinton H. Turner	Haverhill St., No. Reading, Mass.	1BO
F. W. Osborn	21 Highland St., Marlboro, Mass.	1BP
W. R. Mercer	34 Webster St., Allston, Mass.	1BQ
H. C. Ellison	77 Russell Ave., Watertown, Mass.	1BR
C. T. Caswell	106 Franklin St., Framingham, Mass.	1BT
C. R. Stevens	9 Maynard Road, Framingham, Mass.	1BU
L. G. Cummings	83 Marlboro St, Boston, Mass.	1BV
R. H. Shaw	101 No. Central Ave., Wollaston, Mass.	1BW
W. P. Southworth	122 Chestnut St., Wakefield, Mass.	1BX
L. B. Davis	12 Phillips St., Watertown, Mass.	1BY
W. W. Patten	38 Franklin St., Watertown, Mass.	1BZ
J. D. Conboy	12 Beethoven St, Roxbury, Mass.	1CA
L. H. Daykin	339 Beacon St., Somerville, Mass.	1CB
Alfred J. Sivigny	67 Dalby St., Newton, Mass.	1CC
A. P. Graham	19 Gardner St., Woburn, Mass.	1CD
Francis LeBaron	407 Ash St, Brockton, Mass.	1CE
F. C. Bowditch, jr.	164 Rawson Road, Brookline, Mass.	1CF
F. W. Woodworth	173 Bunker Hill St., Charlestown, Mass.	1CG
P. B. Holmes	21 Rockledge Road, Newton Hglds., Mass.	1CH
Henry Slayter	90 Chester Road, Belmont, Mass.	1CI
Arthur Kybert	318 California St., Newton, Mass.	1CJ
Philip F. Robinson	149 Halls Ave., Braintree, Mass.	1CK
E. C. McMahon	9 Vernal St., Everett, Mass.	1CL
Harry Finkelstein	93 Maverick St., Chelsea, Mass.	1CO
C. E. Howell	139 Summer St., Watertown, Mass.	1CP
B. F. Stewart	217 Crafts St., Newtonville, Mass.	1CQ
Charles R. Stevens	19 Agassiz St., Cambridge, Mass.	1CR
F. B. Swett	154 Central St., Saugus, Mass.	1CS
J. L. McGrath	206 Fayette St., Wollaston, Mass.	1CT
F. A. Hurd	159 Bradford St., Everett, Mass.	1CU
Ole M. Hovgard	71 St. Mary St., Brookline, Mass.	1CV
J. S. Day	47 Madison St., Revere, Mass.	1CW
Robt. S. McArthur	2 Cambridge Ter., Cambridge, Mass.	1CX
F. M. Oliver	309 Washington St., Braintree, Mass.	1CY
E. J. Gallagher	16 Appleton St., Atlantic, Mass.	1CZ

Second District

No licenses issued up to time to going to press, but following stations temporarily authorized to transmit using old call, pending receipt of new licenses:

J. O. Smith	Rockville Centre, L. I.	2ZL
Lester Spangenberg	Lake View, N. J.	2ZM

Third District

Temporary authorization pending receipt of new license:

Chas. A. Service, jr.	Bala, Penna.	3QZ

Eighth District

No accurate data, but via radio we have heard:

Mrs. Chas. Candler	315 N. Perry St., St. Mary's, Ohio	8NH

Ninth District

Only one license issued up to going to press:

F. H. Schnell	2220 Roscoe St., Chicago	9AH

Temporary authorization pending receipt of new license:

R. H. G. Mathews	1316 Carmen Ave., Chicago	9ZN

NEWSDEALERS:

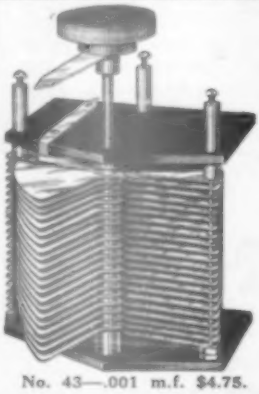
We make our own distribution of QST, and will be pleased to supply you direct, allowing credit for unsold copies returned in their entirety at your expense. Give us a small standing order and watch it grow.

QST BOOSTERS:

Show this to your favorite dealer and get him to send in his order; then tell all the fellows where they can get QST.

AMERICAN RADIO RELAY LEAGUE,

63 Waverly Bldg., HARTFORD, CONN.



No. 43—.001 m.f. $4.75.

A. R. R. L. OPERATORS—THE VARIABLE CONDENSER

you have been looking for—at a price you can afford to pay. The best of materials and workmanship—and look at the prices. Bakelite-Dilecto End Plates—heavy aluminum plates—accurately machined spacers—assembled with care and fully guaranteed. Copper ribbon connection to movable plates which are adjusted to stay in position—but operates smoothly in any position without counterweight.

Complete as shown—PRICES.—include postage for one pound.

No. 2—2	Plate	Vernier		$1.85
No. 7—7	Plate	.0001 m.f.	maximum capacity	2.15
No. 13—13	Plate	.0002 m.f.	" "	2.50
No. 17—17	Plate	.0003 m.f.	" "	2.85
No. 23—23	Plate	.0005 m.f.	" "	3.25
No. 31—31	Plate	.0007 m.f.	" "	3.90
No. 43—43	Plate	.0010 m.f.	" "	4.75
No. 63—63	Plate	.0015 m.f.	" "	6.75

Specify Thickness of Panel and whether Brass or Nickle Screws and Pointer.

THE WIRELESS SHOP

A. J. EDGCOMB.

511 West Washington St., Los Angeles, California.

POSITIONS GUARANTEED

To Every Graduate of Our School
By Four Largest Radio Concerns

$125 PER MONTH PLUS ALL EXPENSES

Modern Equipment Special Short Course
Individual Instruction
Finest Staff of Teachers Available

DORMITORY — SWIMMING POOL

Call or Write for Illustrated Booklet

Y. M. C. A. RADIO SCHOOL

DEPT. R

153 EAST 86TH ST. NEW YORK, N. Y.

"BEST RADIO SCHOOL IN THE EAST"

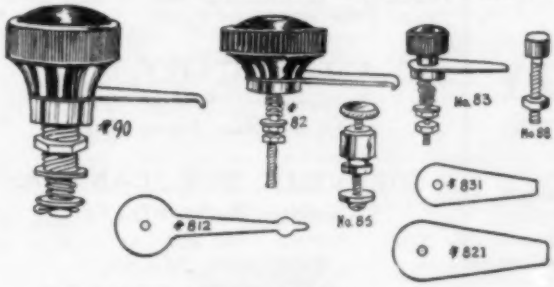
Initial Offering

REMLER RADIO APPARATUS

Highest Quality at Quantity Prices

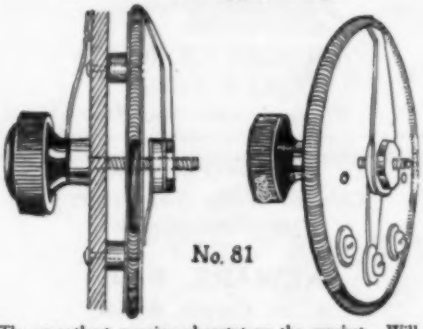
IMMEDIATE SHIPMENTS

Full Line Switches, Levers, Contacts, Binding Posts, etc.



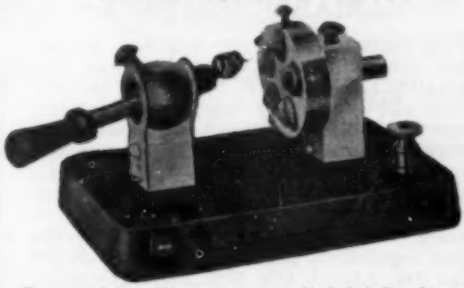
Build your own apparatus and save money. Send for list of parts. ¼" x ¼" or ¼" x ⅛" contacts, ⅜" 6/32 stud and nut. Heavy polished nickel. Each 6c—per dozen 60c. No. 90 switch. Entirely new. Full ¼" steel bearing. Lever pinned on. Can never work loose. Large moulded knob, brass bearing, all metal parts polished nickel. Ideal for couplers, panels, loading coils, etc. Price, $1.25 each

Remler Panel Type Rheostat



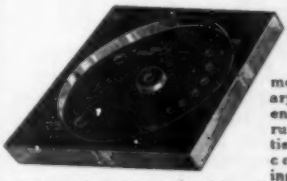
The smoothest running rheostat on the market. Will increase efficiency of your tube control. Resistance mounted on bakelite ring. Unit cheaply renewed. All metal parts nickeled. Complete.....$1.75 each

Full Line Crystal Detectors



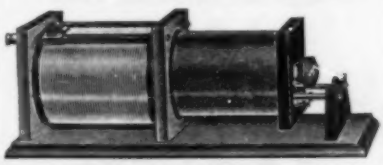
Four models. Mounted on moulded bakelite bases. Prices 95c to $4.00. Cut shows $4.00 model. All metal parts polished nickel. Turret head for 5 crystals. Send for bulletin.

Coupler and Tuner Parts



Complete sets of parts or individual items sold. Save money and build your own apparatus. Cut shows moulded bakelite secondary tuning or loading coil end. Cast in bosses for runner rods, switch and tie rod. Drill marks for contacts and binding posts. Two sizes. 3¾" x 3¾" x ½" to fit 3¼" tubing. Undrilled, 65c each. 1½" x 4½" x ⅝" to fit 3¾" tubing. Marked for 11 contacts, 90c each.

Send for complete parts bulletin.



Complete Line of Couplers

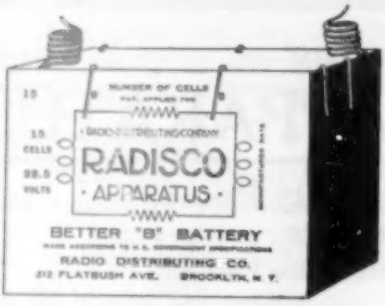
Six different types. Wave lengths 1,500 to 15,000. Full navy and slider types. Parts sold if you want to build your own coupler. Price .....$6.15 to $35.00

Send for coupler circular

Terms and Guaranty: All our apparatus subject to return and full credit if you are not fully satisfied. That is our confidence in the values we offer. All purchases delivered free when cash accompanies order.

DEALERS:--We want reliable representatives. Send for full details.

REMLER RADIO MFG. CO., 62 Post St., San Francisco, Calif.



BETTER "B" BATTERY

The RADISCO BETTER "B" is guaranteed to be manufactured in accordance with U. S. Government specifications and is sold on a money back basis. Among the many reasons it is better are:

VARIABLE VOLTAGE

This feature alone (on which a patent has been applied for), makes the RADISCO BETTER "B" the battery you will eventually buy. Considerable has been written about vacuum tubes that do not require critical voltage regulation, but the fact still remains that the vacuum tube used by the majority of experimenters requires plate voltage regulation. To provide this regulation, taps have been taken off the 1st, 2d, 3d, 6th, 9th, and 12th cells, (see illustration) and it is only necessary to connect these to a switch to provide critical voltage regulation for your tube.

ECONOMY

With the ordinary 15 cell battery, when one cell goes "bad," the entire battery must be discarded. With the RADISCO BETTER "B" you only need test each group of three cells, and short circuit the group containing the "bad" cell.

LOW PRICE

The price of the BETTER "B" is the lowest at which it is possible to sell a first class 15 cell battery.

BETTER "B" No. 1,	
Size 3¼x2x2½ inches,	$1.15
Postpaid	1.25
BETER "B" No. 5,	
Size 6½x4x3 inches,	$2.25
Postpaid	2.60

RADISCO AGENCIES

The BETTER "B" battery is only one of the many articles of standard radio apparatus carried by RADISCO AGENCIES. These Agencies are the leaders in the Radio Field in their locality. It will pay you to communicate your wants to them.

ATLANTIC CITY, N. J.
Independent Radio Supply
118 So. New Jersey Ave.

BIENVILLE, QUE., CANADA.
Canadian Radio Mfg. Co.

BOSTON, MASS.
Atlantic Radio Company
34 Batterymarch St.

BROOKLYN, N. Y.
Kelly & Phillips
Flatbush Ave. near 7th.

CHICAGO, ILL.
Chicago Radio Laboratory
1316 Carmen Ave.

NEWARK, N. J.
A. H. Corwin & Co.
4 W. Park St.
(Note new address)

NEW ORLEANS, LA.
L. A. Rose
4323 Magnolia St.

ALBANY, N. Y.
E. L. Long
21 Magnolia Terrace.

PROVIDENCE, R. I.
Rhode Island Elec. Equip. Co.,
45 Washington St.

If none of the above agencies are in your vicinity communicate direct with the

RADIO DISTRIBUTING CO.
312 Flatbush Ave., BROOKLYN, N. Y.

G. A. STANDARDIZED SUPPLIES

G. A. STANDARDIZED B BATTERIES, 22.5 VOLTS

Built to specifications of U. S. Signal Corps and Bureau of Steam Engineering. Made by the formula used for 90% of the B batteries by the Government. G. A. batteries last longer and are cheaper than flashlight cells. Made for V.T's. and Audiotrons. Need no voltage adjustment tho they can be used with a potentiometer. Two Navy type batteries with one V.T. will transmit 2 to 5 miles telephone, or 4 to 10 miles telegraph. Three or four will give much greater range.
SIGNAL CORPS TYPE, 3¼" long, 2" wide, 2¼" high, operates one V.T. 250 hours continually, average life 3 months, $1.60 prepaid.
NAVY TYPE, 6⅝" long, 4" wide, 3" high, operates one V.T. 1,000 hours continually, average life 10 months, $2.65 prepaid.

G. A. STANDARD H. F. CABLE FOR RECEIVERS AND V. T. TRANSMITTERS

10 No. 38 cable, D.S. covered, for receiving coils. Good for 2-bank winding. 40 turns per inch. Price per 100 feet $0.50
20 No. 38 cable, D.S. covered. Gives greater signal strength and sharper tuning than solid wire. 35 turns per in., 100 feet $0.85
3 x 16 No. 38 cable, D.S. covered. Must be used for V.T. transmitting inductances for maximum efficiency 17 t.p.i., 100 feet $1.60

G. A. LITE MOISTURE PROOF TUBING FOR INDUCTANCES

A new material which reduces high frequency losses, does not absorb moisture, is superior to more expensive tubing. Sold in 12-inch lengths. Intended specially for V.T. transmitting coils, ⅛" thick. 3" o.d. 30c, 3½" 36c, 5" 40c, 5½" 50c.

SEND 3c STAMP FOR THE G. A. INTRODUCTORY BULLETIN

All kinds of needed supplies are listed in the Introductory Bulletin, magnet wire, Bakelite panels for Standardized Panel Construction, wood screws, machine screws, nuts, edgewise copper strip, antenna wire, high tension cable, and other supplies for radio, model, and general experimental work. Everything kept in stock, no delays on substitutions for G. A. customers. Postage prepaid east of the Mississippi River. No orders less than One Dollar.

G. A. SUPPLIES ARE SOLD BY MAIL ONLY. NO GOODS SOLD AT THE NEW YORK OFFICE.

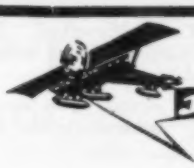
MONEY BACK GUARANTEE ON EVERY ORDER

G.A.

QUICK SERVICE ABSOLUTE RELIABILITY

The General Apparatus Company

158 East 18th Street, New York City



EASTERN RADIO INSTITUTE

TEL. BACK BAY 5964

899 BOYLSTON ST.
BOSTON, MASS.

RADIO

ANNOUNCEMENT!

One of the largest Wireless Telegraph Companies in the country, operating hundreds of ships to all parts of the world, has GUARANTEED to place in good positions EVERY MAN who graduates from the EASTERN RADIO INSTITUTE. We are POSITIVELY the ONLY school in New England who can make this statement and guarantee every man a position. When you realize that it only takes six months in the Day School or nine months in the Evening school to accomplish the work and that the salaries for beginners are from $100 to $125 per month, food and quarters included, and that the entire expense of the course can be returned to you in one month's salary, doesn't this appeal to you? Remember we are the OLDEST, LARGEST, and BEST EQUIPPED telegraph school and have THOUSANDS of satisfied graduates to our credit. THIS SPEAKS FOR ITSELF. Day And Evening Classes. Start any Monday. Other courses for Men and Women in Commercial, Railroad and Brokerage telegraphy. Special afternoon and Saturday classes for Amateurs now forming. Our prospectus for the asking.

ATTEND

MASSACHUSETTS RADIO AND TELEGRAPH SCHOOL

18 BOYLSTON STREET, BOSTON

For Instruction in Radio and Telegraphy. Day and Evening Classes now in Session.

Students may begin course any Monday. Free Amateur Class Saturdays, 10 A.M.

500-CYCLE SET RECENTLY INSTALLED.

Tel. Beach Beach 7168

3" DIAL INDICATOR

3" DIAL ONLY, POST PAID $0.75
3" DIAL WITH BAKELITE KNOB, WITH SET SCREW POST PAID $1.30

BULLETIN No. 1 describing these Dials has been sent to all who sent for our catalog. If you have not received our catalog send 8c in stamps for it and get on our mailing list for future bulletins free.

RADIO MEN!

Make your Apparatus Up-To-Date

INDICATING DIALS

AT A REASONABLE PRICE ARE NOW AVAILABLE

These Dials are fine black polished composition with radial lines and numerals accurately engraved and filled with brilliant white. DIALS are 3 inches in diameter and 3-16" thick. The edges are bevelled. Hole in center will pass 8-32 and there are 3 holes around the center hole to fasten on Knob. (These holes are not shown in cut.) We can furnish Dial alone or with fine Bakelite Knob Mounted. This Knob has a set screw to clamp shaft of instrument to which Dial is applied.

If your dealer cannot supply you send us your order with his name. Immediate deliveries.

FOR SALE AT ALL RADISCO AGENCIES

A. H. CORWIN & CO.

4 WEST PARK STREET NEWARK, N. J.

CHANGE OF PRICES

With Quantity Production and adoption of Automatically Wound Coils, we are glad to announce a Reduction in prices of our Amplifying Transformers as follows:

Type A-2 Fully mounted with Aluminum Supports, Engraved Bakelite Dilecto Panel, and Nickel Plated Bind Posts.....$7.00

With Supports, but without Panel and Bind Posts.....$5.00

Assembled, but Unmounted.....$4.50

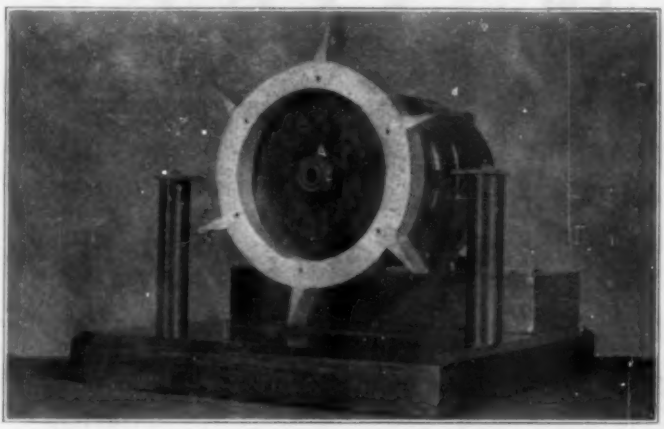
Although originally designed for use with VT-1 Tubes, these are now being used extensively and with excellent results with Marconi V.Ts.

ACME APPARATUS CO.

28 WINDSOR ST., CAMBRIDGE, MASS.

LONG DISTANCE TRANSMISSION

Can be accomplished only by the use of an efficient rotary gap.



Our HY-RAD Rotary Gap, illustrated above, combines substantial mechanical construction with the highest electrical efficiency.

Gives excellent quenching.

Disc measures 9 inches diameter and 1 inch thick, made of aluminum Disc mounted on bakelite center and is carefully balanced and will run absolutely true. Bakelite stationary electrode supports.

Made with either 8 or 10 teeth, as desired

HY-Rad Gap, Complete, with best quality 1/10 H.P. 3400 R.P.M. Induction motor mounted on finished base,.....$27.50
Disc only.....10.00

Write for Bulletin J-19 of high grade receiving apparatus.

CHICAGO RADIO LABORATORY 1316 Carmen Ave., Chicago, Ill.

SPECIAL OFFER

For month of November only we will supply all switch points complete with either brass screw or ¼" hex brass nut at prices listed below

SWITCH POINTS

626

	Doz.	50	100
No. 626—¼" dia. x ⅜" high, tapped 6-32	$0.30	$1.00	$1.75
No. 627—¼" dia. x ¼" high, ½" shank 6-32	.36	1.25	2.00
No. 628—¼" dia. x ¼" high, tapped 6-32	.30	.90	1.50

Above prices plain brass finish. Nickel points 50% advance.

602

628

627

KNOBS

	Each	Doz.
No. 602—1" dia., 8-32 bushing	$0.10	$1.00
No. 606—1¼" dia., 13-16" high	.20	2.00

606

POSTAGE ON ALL ABOVE PARTS EXTRA.

We are agents for all the Reliable and only the reliable Wireless Manufacturers. Send us your orders and inquiries for any apparatus made by C. Brandes, Inc., J. H. Bunnell & Co., Clapp-Eastham Co., DeForest Radio Tel. & Tel. Co., A. H. Grebe & Co., Wm. J. Murdock Co., Thordarson Elect. Mfg. Co., and others. We will give you prompt attention.

SEND TODAY FOR OUR CIRCULAR G SHOWING COMPLETE LINE

SHOTTON RADIO MFG. CO., P.O. Box 3, Scranton, Pa.

BRANCH: 8 Kingsbury St., JAMESTOWN, N. Y.

BAN OFF

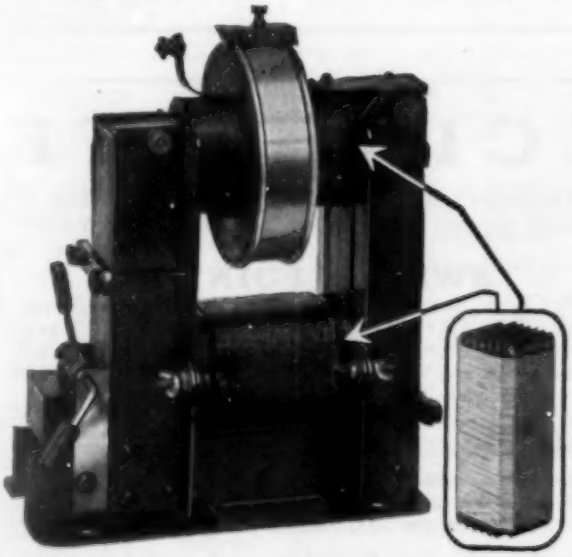
ON OCTOBER 1ST THE NAVY DEPARTMENT REMOVED THE BAN ON AMATEUR TRANSMITTERS. WHO WILL BE THE FIRST A. R. R. L. AMATEUR TO TRANSMIT

1500 MILES ON 200 METERS

AND WIN THE THORDARSON PRIZE? GET BUSY—OTHERS ARE TRANSMITTING NOW.

As an award to the first A. R. R. L. amateur transmitting 1500 miles on 200 meters and complying with the conditions as outlined in the August QST, we are going to give the winner one of these new 1 K. V. A. 25,000 volt wireless transformers or $35.00 in cash. Our T-20 catalog mailed on request.

IN A CLASS BY ITSELF



ALWAYS ON TOP AND SECOND TO NONE

WRITE FOR OUR CATALOG T-20

THORDARSON ELECTRIC MFG. CO.

501 S. JEFFERSON STREET CHICAGO, ILL.

UNIVERSAL SYSTEM
RADIO APPARATUS

Efficient equipment for all purposes

Damped and continuous waves

Send stamp for Catalog and and mention QST

Universal Radio Mfg. Corporation
ELMIRA, N. Y.

WIRELESS TELEGRAPHY PAYS
BIG MONEY
We Teach You in Two to Three Months

There is a great shortage of wireless telegraphers, due to enormously increased demand. Ships cannot or will not leave port without wireless operators; the pay is high; advancement rapid; the hours are short—it's worth while. Write for catalog—learn how quickly and easily you can qualify for positions paying

$125.00 PER MONTH INCLUDING FOOD AND QUARTERS AND TRANSPORTATION TO PORT

Our scientific system of teaching wireless telegraphy perfected by a corps of practical experts, makes you fully competent in two to three months. Wireless is easy to learn—the cost is low and the result is certain. Hundreds of our graduates are profitably employed and are doing duty and seeing the sights in every port of the world. This is your opportunity.

We put you in touch with the position you want. Write today for catalog. It explains all fully. Our course is recognized and endorsed by United States Government Officials.

Our course in **Railroad, Commercial** and **Brokerage Telegraphy** may interest you. Taught in **TWO** to **FOUR MONTHS**, by **phonographic system in your own home** in spare time. Big pay—Big demand—Write today.

CHICAGO TELEGRAPH INSTITUTE
America's Finest School
3412 Michigan Ave., Chicago.

NEW HI-VOLT STORAGE BATTERY

A new development in vacuum tube reception has been made in this New Hi-Volt Storage Battery. The feature is a self-contained battery and rectifier. The battery has a voltage of 24 and under normal use holds its charge for three weeks. When discharged all you do is to connect a 110 volts A.C. line and in three hours the battery is fully charged and ready for use.

Economical---Efficient---Lasting

Combined Battery and Charging Rectifier as Illustrated, $15.00

Send 6c. for our catalog No. 1 and description of Hi-Volt Storage Battery.

The C. D. Tuska Company
HARTFORD, CONNECTICUT

Federal Audio-Frequency Transformer

The No. 226-W
Price $7.10

The only Audio-Frequency Transformer designed for use with the Marconi V. T. Class I and II and approved by expert engineers.

WONDERFUL RESULTS ARE OBTAINED IN AMPLIFICATION BY IT

All who have a Marconi tube, or one of same internal impedence, should have a FEDERAL No. 226-W, Type A, in order to get high class results.

WRITE FOR BULLETIN 102-W

We also furnish the Marconi Tubes, Standard Mountings and Leak Resistances, at regular prices.

Federal Telephone and Telegraph Co. BUFFALO, N. Y.

MANUFACTURERS OF

STANDARD AIR CORE AUDIO-FREQUENCY TRANSFORMERS. "LIBERTY" HEAD TELEPHONES. FAMOUS "CENTURY" HIGH-FREQUENCY BUZZERS. THE ORIGINAL ANTI-CAPACITY SWITCH. STANDARD PLUGS, JACKS AND ACCESSORIES.

SOMERVILLE RADIO LABORATORY
SOMERVILLE MASSACHUSETTS
102 HEATH ST.

Be Patient

We use care in designing our SORALA RADIO SPECIALTIES SIMPLICITY which we feature makes for EFFICIENCY as well as REASONABLE PRICES. Send 4 cents for Bulletin out next month.

SORALA VT sockets, $1.25 each, 5 for $5.00; Ready now. All Bakelite non-moulded construction with ample connectors and phosphor-bronze spring contacts. SORALA Grid Leak Attachment, $0.25 additional. SORALA VT amplifiers (unassembled) $12.00 per step. A reasonably priced tube transmitter, ready soon.

The Oldest Radio Supply House in New England

Agents for all reliable lines of apparatus

GEO. S. SAUNDERS CO.

168 Washington St. 11 Devonshire St.
BOSTON, MASS.

LEARN WIRELESS TELEGRAPHY

Fascinating and Educational Work—Big Salaries—Prepare Now

The United States Shipping Board is making heavy demands upon us for **Dodge-trained** wireless operators. Travel all over the world, secure, free, unsurpassed living accommodations and earn a big salary.

We Also Teach Morse (Wire) Telegraphy and Railway Accounting

School established 45 years. Endorsed by wireless, railway and telegraph officials. Low rates. Students can earn living expenses while attending school. **Catalog Free. Write Today.**

Dodge's Telegraph and Wireless Institute **27th St.** ***Valparaiso, Indiana***

CAN WE SEND YOU A GENUINE TWO FILAMENT AUDIO TRON BULB C. O. D. $4.50—No Other Charge

We were the first to sell the AUDIO-TRON. Our standing guarantee is that the bulb is sensitive as a detector, a powerful amplifier and oscillator. We have had no "comebacks" against our bulbs during the past four years. Can we send you interesting literature?

JENSEN ELECTRIC COMPANY, 1949 Huron Street, CHICAGO ILL.

CLASSIFIED ADVERTISEMENTS

Five cents per word per insertion, in advance. Copy must be received by the 10th of month for succeeding month's issue.

TELEGRAPHY (both Morse and Wireless) AND RAILWAY ACCOUNTING taught thoroughly and quickly. Big salaries now paid. Great opportunities. Oldest and Largest School—est. 45 years. Catalog free. Dodges Institute, 28th St., Valparaiso, Ind.

WANTED—An Omnigraph, Continental discs. Post Office Box 629, Hartford, Conn.

MOTOR-GENERATOR 110 D. C. to 60 V. A. C. 1/6 Kw. Starter and Clapp-Eastham transformer. Range 100 miles, $45. Particulars and photograph 10 cents in stamps. E. G. Baier, 253 Ninth St., Brooklyn, N. Y.

FOR SALE—1 K.W. Thordarson and 1 K.W. Blitzen trans. Perfect condition. First good offer takes them. M. Frye, Jr., Box 187, Vineland, N. J.

FOR SALE—Mesco 3" spark coil; Murdock Oscillation transformer and aerial switch. Bargain. E. Cyriax, 219 East 71 Street, New York City.

Amplifier Units, two step $15. Amplifier Coils $6. Send stamp for circular. Radio Sales Co., 1629 McAllister Street, San Francisco, Calif.

FOR SALE—⅓ K.W. Packard Transformer. Gray, 443 Northampton, Easton, Pa.

FOR SALE—Old 9GY Equipment; write for list. L. Armstrong Kern, 1503 Cambridge Road, Ann Arbor, Michigan.

Antennas built and erected. Masts put up. All kinds of Antennae construction work done. Will go anywhere in New England. Saturday afternoons and Sundays preferred. J. Limone, 53 Granville Ave., Medford, Mass.

FOR SALE: Mignon Undamped Receiving Set RW3, cost $100.00, sell $60 00, A1 condition. Theodore Olson, 528 Market St., Portland, Oreg.

FOR SALE—Undamped Receiving Apparatus, Cheap, Write. G. L. Brewer, Big Pool, Maryland.

NEW: Moorhead-Marconi Tubes $6.25, Army "B" Batteries $0.98 prepaid: Apparatus at reduced prices. Natalish, 145 West 55 Street, New York City.

WANTED: Guns, Apparatus, Sock, Box 101, Stockbridge, Mass.

WILCOX PANEL SWITCH
"The Best"
1½" Radius Postpaid
Pol. brass fin. switch 50c
Nickle pl. fin. switch 60c
Turned and pol. knob 25c
Brass switch points 2c
Nickle pl. switch pts. 4c
THE WILCOX LABORATORIES Lansing, Mich.

EUGENE C. BROWN
PATENT LAWYER
Electrical Engineer, Lehigh Univ.
Former Examiner Elec. Div. U. S. Patent Office
PATENTS AND PATENT LITIGATION
734 Eighth St., N. W. WASHINGTON, D. C.

MR. AMATEUR
HIGH FREQUENCY CABLE—(LITZ).
16-3-38 and 16-2-38 D. S. C. Enameled
GREY SEAMLESS CARDBOARD TUBES
Bakelite and rubber panels, vacuum tubes. Write for circular on Honeycomb Coil Mounting—it will interest you. Wholesale and retail.
A. T. HOVEY
61 Belvidere Street, Near Mechanics Bldg., BOSTON, MASS. (Open Evenings)

WIRELESS APPARATUS
We Carry a Full Line of Wireless Supplies for the Amateur.
JAMES W. POOLE, Inc.
64 Kingston St., Cor. Bedford
Boston, Mass.
Est. 1887.

NEW ORLEANS
WIRELESS SUPPLIES AND MINERALS OF ALL DESCRIPTIONS
L. A. ROSE
4323 MAGNOLIA STREET
NEW ORLEANS, LA.
SEND 6 CENTS FOR CATALOG

PAPER TUBES
For constructing loose couplers, loading coils, variometers, etc., smooth, round, gray, seamless, tubes.
FOR 3500 METER COUPLER
Primary 3¾" outside dia. 7" long—25c
Secondary 3¼" outside dia. 6" long—20c
FOR VARIOMETERS
Primary 4¾" outside dia. 2½" long—12c
Secondary 3¾" outside dia. 2" long—10c
FOR LOADING COILS
3¾" Outside Dia. 14" long—40c
4¾" Outside Dia. 14" long—50c
Special Lengths Cut to Order
To 15" long 3¼" dia.—4c per in.
3¾" dia.—5c per in.; 4¾" dia.—6c per in.
All tubes have ⅛" wall.

Laboratory Signs
Attractive 8" x 10" signs printed on high quality coated white cardboard in selected wordings for the electrical experimenter.
1. DANGER! HIGH VOLTAGE
2. EXPERIMENTAL RADIO LABORATORY NO ADMITTANCE
3. GOVERNMENT LICENSED RADIO STATION
4. DO NOT TOUCH THE INSTRUMENTS
5. PLEASE BE QUIET WHILE THE OPERATOR IS RECEIVING
15c EACH, ANY TWO FOR 25c
ALL 5 FOR 50c

IMMEDIATE SHIPMENTS, POSTPAID.
THE TAYLOR COMPANY, BOX 1043C, LOWELL, MASS.

EVERYDAY ENGINEERING

Each month contains the equivalent of a 60 page book on radio as well as a fund of articles on experimental work. And the price is only ~ Fifteen cents.

EVERYDAY ENGINEERING MAGAZINE
605 PUTNAM BLDG, 45th ST, NEW YORK

SWITCH CONTACT POINTS

Very Accurately Machined from Brass
Heads ¼" Dia. x .150" high—Shank, 8-32 thread x ⅝"

—PRICES—

Polished Brass—ea. 2½c.—30c. doz.
Polished Nickle—ea. 4c.—48c. doz.

BRASS BINDING POSTS

A good post at a low price of 10c. ea.
polished nickle plate at 15c. ea.
Large Lathe Turned Knobs—8-32 thread—20c.

Send for new Circular on Parts and Instruments.

THE WIRELESS SHOP

511 West Washington St., Los Angeles, Cal.

THE "RVA" BULLETIN

Published Each Month
Tells How Responsible Amateurs Can Purchase

RADIO APPARATUS

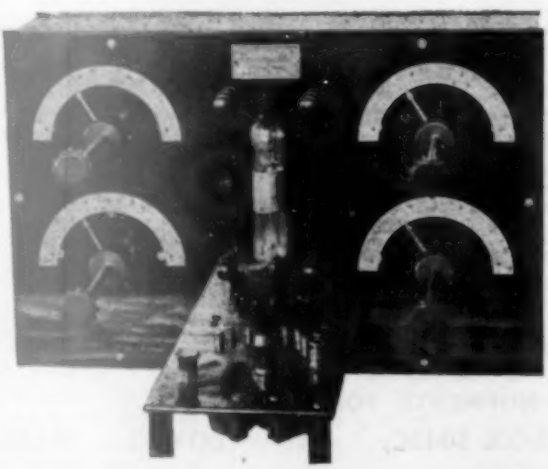
on the

INSTALMENT PLAN

Ten Cents brings a Loose Leaf Binder and the RVA BULLETIN each Month

J. DONALD VANDERCOOK

PARKSIDE AVE., LOMBARD, ILL.



"COS-RADIO"

Mark of Quality

Our Variable-Tron Set
"A Thing of Beauty"

Four Variables and complete Tron Equipment. Highly Efficient

Do You Hear POZ?
Our Long Wave Receiving Cabinet Does It.

Get Our Prices

Everything Radio

WATKINS MFG. CO.

Wichita, Kansas

AERIAL WIRE

7 strands of No. 22 Copper High Tensile strength and 100% conductivity. Supply limited at this price. Shipping weight about 15 lbs. per 1000 ft. Postage extra No C. O. D's. at this low price.

1 CENT PER FOOT

$9.00 Per Thousand

Genuine 2 Filament Audiotrons Guaranteed Super-Sensitive

$5.00 POSTPAID INSURED

LEE A. BATES

8 Moen Street, Worcester, Mass.

THE RADIO ELECTRIC CO.

Special B battery 22 V 5 Amps $1.15, Audiotron detector tubes $5.00 postpaid and insured. Grid leaks, condensers and all vacuum tube supplies.

CONCENTRATE YOUR BUYING by purchasing all of your equipment through us. We handle all reliable standard instruments, including Baldwin receivers, DeForest apparatus, Grebe's latest developments and many others of the same grade.

RADIO ELECTRIC CO.

4614 HENRY ST. PITTSBURG, PA.

Audiotron B-Batteries

30 cell 45 volt batteries will outlast three set of flashlight cells. Taps brought out for six different voltages.

$5.50

Postage, $0.10

Prices on other Apparatus upon Request.

F. C. MYERS

45 Albany Trust Co. Bldg., Albany N. Y.

Radio Apparatus

Phones	Knobs
Condensers	Formica
Inductances	Contact Points
Rheostats	Binding Posts
Switches	Copper Strip
Vacuum Tubes	Aerial Wire

CATALOG $0.06

KLAUS, Eureka, Ill.

Can you beat the Double A Quality Goods?

Short wave regenerative sets, 150-600 meters $25.00:

Two Step Amplifiers Guaranteed to increase signals 60 Times, Price, $25.00, without Bulbs.

Audion Control Panels—$11.75.

All apparatus complete with polished Cherry Cabinets, and Bakelite Panels.

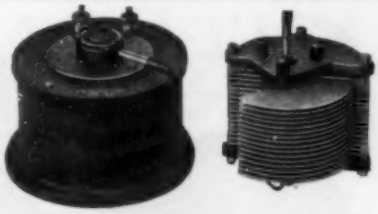
ALL OUR INSTRUMENTS ARE GUARANTEED

NOTE—Prices of our products as advertised in October QST are effective until November 15th only.

We advise operators to place their orders early, to insure early delivery; and avoid increasing costs; these prices are effective until DECEMBER 15th

RADIO EQUIPMENT COMPANY

1525 North Fawn Street, Philadelphia



Variable Air Condenser

TYPE 182

A high grade condenser with plates designed to give approximately even variation of wavelength throughout the scale.

Made in two sizes: .0007 M. F. at $10.00 and .001 M.F. at $13.00.

Full data on request.

General Radio Co.

WINDSOR STREET

CAMBRIDGE MASS.

8,000 MILES

is the record (amateur) with our Audio-Tron Detector.

THE GENUINE AUDIO-TRON

DETECTOR - AMPLIFIER - OSCILLATOR

Price postpaid $4.50

Can we send you one C. O. D. ?

No extra charge.

Jensen Electric Co.

RADIO APPARATUS

1949 Huron Street CHICAGO, ILL.

TWO FILAMENT BULBS ONLY

"ASK ANYONE WHO HAS USED IT"

"THE BEST I EVER WORKED"

"The Brandes Headset Is The Best I Ever Worked. Others Look Like a Plaything Beside It." (Testimonial from an expert. Name on request.)

Professionals and Amateurs the world over are enthusiastic about the range and absence of blurring in the

BRANDES WIRELESS HEADSET

'Superior' 2000 ohms $7

TRIAL OFFER *Test out Brandes Wireless Receivers against any other make. Test them for sensitiveness, clearness and distance. If within ten days you're not only satisfied but enthusiastic over them—back comes your money without a question.*

Prove for yourself the fine quality, the "matched tone." The two diaphrams, toned exactly alike, strengthen the signals and prevent blurring. Used by many U. S. Gov't experts, and experts abroad; by colleges and technical schools; and by professionals and amateurs everywhere.

SEND 4c. FOR CATALOGUE F

C. BRANDES, Inc.

Room 821, 32 Union Square, New York
WIRELESS RECEIVER SPECIALISTS

THE NEWEST THINGS

IN WIRELESS

ARE IN THESE THREE BOOKS

Just Off the Press

RADIO INSTRUMENTS AND MEASUREMENTS

Every amateur should have this book as it answers the questions you want to ask and covers all phases of the subject matter indicated by its title. Cloth Bound, 320 Pages, $1.25.

THE WIRELESS EXPERIMENTERS' MANUAL

By E. E. Bucher. Mr. Bucher's latest book. The only one that comprehensively covers all phases of wireless work, including the latest practices in both Radio Telegraphy and Telephony. Most complete text book on these subjects yet published. Cloth Bound. Approximately 300 Pages. Price $1.75.

HOW TO CONDUCT A RADIO CLUB

By E. E. Bucher. One of the most popular wireless books ever published. Covers parliamentary procedure, indoor and outdoor experiments, 5,000-mile receiving sets, use of vacuum tubes and many other subjects. Paper Cov. 148pp., 50c.

THE WIRELESS AGE

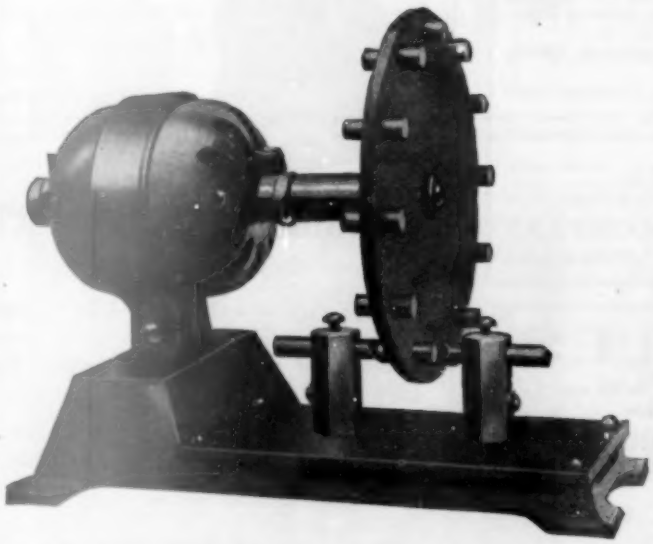
A monthly magazine that will keep you posted on the up-to-the-minute things in wireless communication. Official organ of the National Amateur Wireless Ass'n. Price Per Year $2.00.

SPECIAL COMBINATION PRICE, ALL FOUR ONLY $4.50

WIRELESS PRESS

1852 Woolworth Building, New York

"Send for latest catalog"



KLITZEN ROTARY SPARK GAP

Federal Law requires a rotary spark gap in every transmitting station. When you buy a KLITZEN you get the most efficient non-synchronous gap. 3 inch current travel. Balanced disc—absolutely true—no wobble or vibration. Renewable Spark Points. Highest grade, universal motor—operates on 110-120 volts A. C. or D. C. 25-60 cycles. Speed with Disc 4000 R.P.M.—quick pick up—practically noiseless.

ORDER AT ONCE.

PRICE $22.00

Shipping Weight 8 lbs.

Klitzen Radio Manufacturing Co.

1501 Flett Ave., Racine, Wis.

RADIO EXPERTS

The ***Amateur*** *or the* ***Professional*** *can depend upon our advice.*

It means "short cuts" and the best of results with your apparatus.

This service is ***absolutely free.***

Everything in Radio Apparatus from the "Tower to the Key."

A. P. Merchant Co.

9 AVERY STREET BOSTON

RADIO APPARATUS

Distributors of All Prominent Makes:—
DeForest, Crebe, Murdock, Wireless Specialty, General Radio, Clapp-Eastham, Brandes, Acme, Audiotron Sales, Federal Tel. and Tel. etc., etc. You can place your orders right from their catalogs and secure immediate delivery.

LARGEST AND BEST STOCK OF ANY HOUSE IN NEW ENGLAND.

SHORT-WAVE REGENERATIVE RECEIVER TYPE CR-2
Wave-length range: 170 to 600 meters

Shipping weight 21 pounds. PRICE $46.00

EXCLUSIVE DISTRIBUTOR OF GREBE PRODUCTS IN NEW ENGLAND.

For real prompt delivery send us your orders for honey-comb coils, Unit panels, all kinds of vacuum tubes, all makes of telephones, radio textbooks, amplifiers, control panels. etc. etc. Remember this material is carried right in stock and shipped the same day as order is received. GIVE US A TRIAL.

F. D. PITTS CO., Incorporated
12 Park Square, Dept. A, BOSTON, MASS.

EVERYTHING FOR AN IDEAL AERIAL

COMPLETE OR PARTS — "CQ — CQ — CQ" — FOR LAND OR MARINE STATIONS

OUR SPECIALITY

SPARS
BRIDLES
INSULATORS
WIRE — ROPE
MASTS

TO AMATEURS { 2, 3, 4 & 6 WIRE ANTENNAS for 200 meters; LONG WAVE 2 WIRE RECEIVING ANTENNAS. Galv. All STEEL-PIPE MASTS—Any Height.

Construction: Specially designed, turned and perfectly tapered SPARS—fitted with galv. steel mast bands; best grade flexible galv. wire BRIDLES; galv. pulleys; ELECTROSE INSULATORS; seven strands PHOSPHOR BRONZE ANTENNA WIRE; high-grade WEATHER-PROOF HOISTING ROPE.
MASTS: Telescopic 24" riveted joints; durable and beautiful; sur-mounted with genuine Gold Leaf covered Ball.

"Made in America"

Distributors of HIGH GRADE RECEIVING APPARATUS

Prices quoted on application. Specify your particular requirements.

"K-K" "AT YOUR SERVICE" "K-K"

NORTH AMERICAN AERIAL SPAR MFG. CO. Dubuque, Iowa

"Hear 'Em All"

The ether is free again. Why not make yours one of the stations that are "doing" things? Hear those fellows across the continent. You can bring in piercing signals from them with a

Type RORB, Price $45

GREBE RADIO

Two-Stage Audio-Frequency Amplifier

Designed since the Armistice, this Amplifier embodies the latest engineering achievements. The howling, found in other types, has been eliminated without sacrificing efficiency. The cover is hinged, affording accessibility to all parts. Sockets accommodate the standard 4-prong tube.

The wiring and mechanical construction are characteristic of Grebe workmanship. Better be sure **your** Amplifier is a Grebe.

Write today for free bulletin describing Grebe Amplifiers;—complete catalog sent upon receipt of 10 cents.

A. H. GREBE & CO., 74 Van Wyck Blvd., Richmond Hill, N. Y.

The BARR
MERCURY-CUP WIRELESS DETECTOR

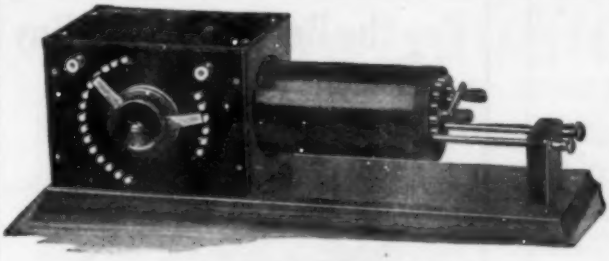
The most efficient Detector on the market. Tested by the United States Government and Marconi Wireless Telegraph Company.

Increases the efficiency of every wireless receiving set by making the signals clear, sharp and distinct.

Instantly adjustable at a constant pressure.

FOR FULL INFORMATION AND PRICE — WRITE

The Barr Mercury-Cup Detector Dept. E, THE WYOMING, WASHINGTON, D. C.



ARNOLD NAVY MODEL LOOSE COUPLER

Altho this instrument has been before the public for five years, the demand for it is just as persistent; and altho many pre-war standards have been swept away you will find, after much experimentation with new-fangled ideas, that for selectivity and sharpness of tuning you "have to go some" to beat a well-designed Loose Coupler.

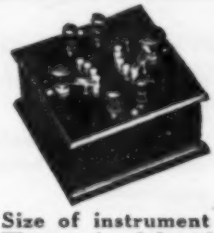
The instrument illustrated above is correctly designed, its workmanship the best, and it presents much better value than you expect—if you could see one and operate it, you would expect it to cost more.

For special design binding posts, knobs, switches, rheostats, and in fact better grade accessories, send two-cent stamp for my bulletin.

J. F. ARNOLD

(Established 1910)

2082 LEXINGTON AVENUE NEW YORK



PERFECTION TUNERS

20,000 meters Long Wave Receiving Tuners, a revolutionary design, equally efficient on loop aerials, overhead, or underground; work on a long aerial as well as a short. XDA comes in on the first tap, NSS on the fourth. The wave length range with .001 M.F. Perfection Condenser is from 3500 to 20,000 meters.

Wiring diagram is on the bottom of each instrument and this one must be followed. No tickler coils are used or needed. Size of instrument is 4¾ x 4¾ x 2½, and it will readily set in a deForest panel. The top is of formica—switches and points highly nickle-plated, hard rubber binding posts, and absolutely guaranteed as represented or money will be refunded.

The price of this tuner is $15.00, delivered to you.

PERFECTION 200-METER REGENERATIVE TUNER

Same size as above and same weight, with the exception that hook-up shown on bottom is the same as shown in QST, page 5, December, 1916.
Price: $15.00 delivered to you.

PERFECTION KNOCK-DOWN VARIABLE CONDENSERS

43-plate—capacity	.001 M.F.	$2.50
21-plate—capacity	.0005 M.F.	2.25
11-plate—capacity	.00025 M.F.	1.75

Aluminum plates, .0156; fibre tops and bottoms; brass washers, brass dial graduated zero to 180; shipped in a neat box, knocked down—you assemble them yourself—no outside cover, but just as shown in the cut, designed for panel sets; no screws are furnished to fasten this to the panel. The 11-plate is just the thing for the grid; the 43, for the primary; and the 21, for the secondary.

TRESCO, P. O. Box 148, DAVENPORT, IOWA

DUCK'S BIG 300 PP. Wireless and Electrical Catalog

Is now as it always has been, the largest and most complete and dependable Wireless Catalog published. Mailed for 12c. in stamps or coin which may be deducted on first order of one dollar. Catalog not sent otherwise. This catalog costs us twice the price of other catalogs.

Everything in wireless worth while is listed in this catalog. The experienced amateur will tell you to see our catalogue before buying. You are thereby insured against an unwise purchase. It is the Beacon Light to guide you right in the selection of your wireless apparatus. No bigger or better values are obtainable elsewhere. Send for revised price list. It is yours for the asking.

THE WILLIAM B. DUCK CO. 243-245 Superior St., Toledo, Ohio

MURDOCK

NO. 55

2000 OHM DOUBLE SET

$4.50

3000 OHM DOUBLE SET

$5.50

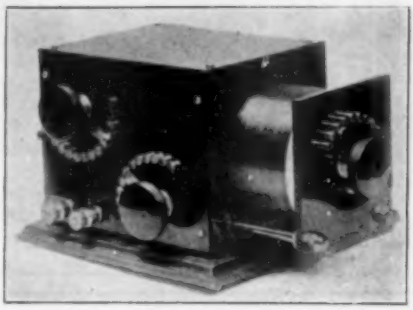
Made for long and
Useful service in
Radio stations where their
Dependable and sensitive
Operation makes them the
Choice of those who
Know GOOD 'phones.

ORDER YOUR SET NOW—
Try it out thoroughly.
IF IT DOESN'T SUIT, SEND IT BACK AND GET YOUR MONEY

Bulletin 19 shows a splendid line of the type of apparatus you want. Send for a copy.

WM. J. MURDOCK CO.
65 Carter St.
CHELSEA MASS.
221 SECOND ST., SAN FRANCISCO, CALIF.

Buy the Best When You Buy



THE BEST COSTS YOU LESS WHEN YOU BUY FROM US.

This 200 to 2500 meter loose coupler costs $18.00 You cannot buy a better instrument if you pay more.

Radio Equipment Company
630V Washington St., Boston, Mass.

WIRELESS TAUGHT BY MAIL

By the Largest Radio School in the World

Staff of high class government instructors; 16 weeks' course. Now placing our graduates in fine positions. Pay runs from $110 per month and living expenses, up to $3500 per year.

REDUCTION IN TUITION TO GRADUATES

and, under certain conditions, you may obtain the course for practically nothing. We need thousands of operators, inspectors and radio aids. Fascinating work; interesting study; takes only a little bit of your time daily. Write today for illustrated catalogue and details of our profit sharing plan with students.

SERVICE RADIO SCHOOL

Dept. T, 900-2 Pa. Avenue — Washington, D. C.

BURGESS "B" BATTERIES

22.5 VOLTS
15 CELLS

THREE SIZES
No. 2156—3" x4" x6 5/8"
No. 5156—2 11/16" x2 9/16" x4 1/8"
No. 4156—2 1/2" x2" x3 3/8"

BURGESS "B" BATTERY construction is being specified by the Government for its vacuum tube batteries. They have long life, high capacity and noiselessness.

Write for prices and information to

BURGESS BATTERY COMPANY

Laboratories
Madison, Wisconsin

Sales Office
Harris Trust Bldg., Chicago

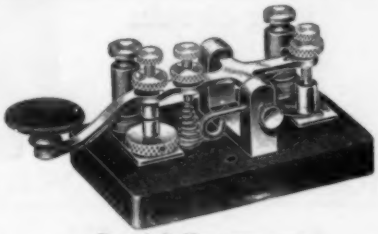
Manufacturers of Reliable Instruments and Distributors of All Prominent Makes of

RADIO APPARATUS

Everything Essential to the Successful Installation of A RADIO STATION

Bunnell Apparatus is Sold by Dealers Everywhere

Catalog 40-Q on Request



Special Feature—
The Straight Line Radio Key

J. H. Bunnell & Co. *32 Park Place, New York*

A New Variometer for the Amateur

Type S.S. Variometer, in three sizes: maximum inductances, 1 millihenry, 5 millihenries, 20 millihenries. Mounted $20.00; unmounted $16.00.

Variometers provide an inductance as easily and gradually variable as a rotary condenser. They are the ideal inductance; efficient, no poor contacts, dead-end losses or capacity losses from multiple taps.

Clapp-Eastham Variometers are designed to give the amateur a Precision Instrument at a low price. Compact in size and beautiful in workmanship. Especially designed to minimize distributed capacity. Readily adaptable to panel mounting. Equipped with a special drum switch automatically actuated by the control knob, whereby the coils are in parallel the first half revolution providing an inductance continuously variable thru 360 degrees, giving double the range of adjustment available wth other variometers.

Fully described, with other New Developments, in our interesting Bulletin Y.

NEW BULLETIN R OF RECTIFIERS FOR STORAGE BATTERY CHARGING NOW READY.

CLAPP-EASTHAM COMPANY

141 MAIN STREET CAMBRIDGE, MASS.

REMLER RADIO MFG. CO., 62 Post St., San Francisco, Cal., Pacific Coast Representatives

PAUL UNIPIVOT GALVANOMETER

TYPE I

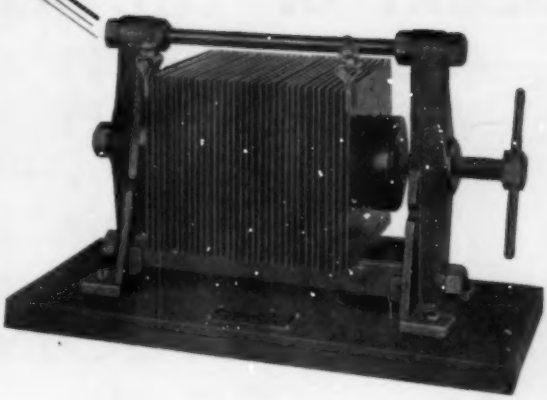
Excellent for wing circuits of vacuum tubes

Resistances of 5, 10, 50 and 100 ohms

Rawson Electrical Instrument Co.

4 NORFOLK ST., CAMBRIDGE, MASS.

Other AMRAD *products that every amateur should use are:* AMRAD *Detector Stand,* AMRAD *Antenna Switch,* AMRAD *Induction Coil--for use where AC is not available. Ask your dealer about* AMRAD *products, the commercial grade apparatus for amateur use.*



AMRAD
Quenched Gap
$17.50

AMRAD
Variable Air Condenser

AMRAD
Detector Stand

AMRAD
Variometer

Now that the ban is off--

there will be more severe government restrictions imposed than ever before.

To secure *three to four times your present antenna energy,* to assure low decrement and so comply with government regulations, amateurs should use the

AMRAD

QUENCHED GAP

The AMRAD Quenched Gap does not necessitate the use of 500 cycle generator. Properly operated with a 60-cycle circuit, it will give a 240 spark note.

Our bulletin No. 12, sent at your request, will explain how this may be done.

Folder, giving detailed specifications of the Quenched Gap will be sent at your request. Address Department R 5.

AMERICAN RADIO AND RESEARCH CORPORATION

21 PARK ROW NEW YORK

Factory at Medford Hillside, Mass.

THE HEART OF THE WIRELESS

An Amateur Station Without a Vacuum Tube Is Years Behind the Times

MARCONI V.T.

$7.00 each

Under agreements recently effected the Marconi V. T. is the only vacuum tube, or audion, which may be sold to amateurs, laboratories, schools of instruction and experimenters.

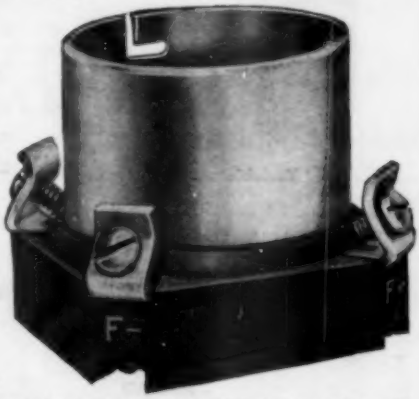
THE APPROXIMATE OPERATING LIFE OF THE MARCONI V. T. IS 1,500 HOURS.

Fleming Pat. No. 803684
DeForest Pat. Nos. 841387-879532

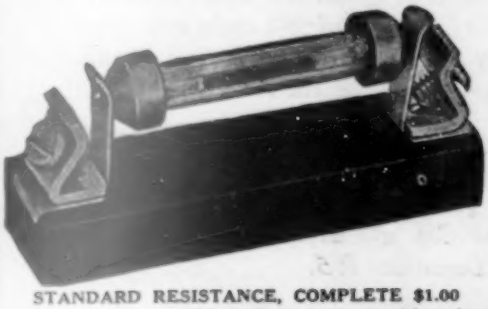
Class I.—Designed for use as a detector; operates with plate potential of 20 to 60 volts.

Class II.—Designed for use as an amplifier; plate potentials from 60 to 110 volts may be applied.

Tubes in either class may be used for detection or amplification, but those of Class I are best as detectors, and Class II tubes are superior as amplifiers.



STANDARDIZED SOCKET $1.50 additional



The Marconi Resistance, connected in the circuit between the grid and the filament of the Marconi V. T., is made in the following standard sizes:

½ megohm, 1 megohm, 4 megohms, 6 megohms.

Resistances of any special fractional values up to 6 megohms can be supplied.

STANDARD RESISTANCE, COMPLETE $1.00

Send all remittances with order to COMMERCIAL DEPARTMENT

Marconi Wireless Telegraph Company of America

Sole Distributors for De Forest Radio Telephone & Telegraph Co.

227 BROADWAY, NEW YORK

RETAIL SALES AND EXHIBITION ROOMS, 25 ELM ST., NEW YORK

BRANCH OFFICES:

Schofield Bldg., Cleveland, Ohio
American Bldg., Baltimore, Md.
Insurance Exch. Bldg., San Francisco, Cal.
136 Federal St., Boston, Mass.
301 Commercial Bank Annex, New Orleans, La.
109 South 2nd St., Philadelphia, Pa.